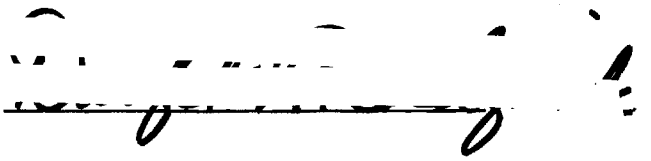
In presenting the dissertation as a partial fulfillment of the requirements for an advanced degree from the Georgia Institute of Technology, I agree that the Library of the Institute shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to copy from, or to publish from, this dissertation may be granted by the professor under whose direction it was written, or, in his absence, by the Dean of the Graduate Division when such copying or publication is solely for scholarly purposes and does not involve potential financial gain. It is understood that any copying from, or publication of, this dissertation which involves potential financial gain will not be allowed without written permission.



7/25/68

AN APPLICATION OF THE ALDEP COMPUTER PROGRAM FOR THE DETERMINATION OF A HOSPITAL LAYOUT

A Thesis

Presented to

The Faculty of the Division of Graduate

Studies and Research

by

Dwight Rogers Sedgwick

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Industrial Engineering

Georgia Institute of Technology

May 1970

AN APPLICATION OF THE ALDEP COMPUTER PROGRAM FOR THE DETERMINATION OF A HOSPITAL LAYOUT

Approved:

Chairman

Date approved by Chairman: 5/4/70

ACKNOWLEDGMENTS

Appreciation is gratefully acknowledged to Dr. Gerald L. Delon, School of Industrial and Systems Engineering, Georgia Institute of Technology and Professor Joseph N. Smith, School of Architecture, Georgia Institute of Technology, both of whom served on the reading committee for this thesis and were most constructive with their criticism. Many thanks go to Mr. Wayne Evans, of International Business Machines, who provided to basic ALDEP computer program used herein. Thanks also goes to the University of Georgia Computer Center which provided computer time to run the ALDEP program. Much appreciation is also extended to Mr. Redding, administrator for the Atlanta Eye Clinic and Hospital, for his time and information given relative to his hospital as used in this thesis.

Special thanks and appreciation go to Dr. Paul T. Eaton, School of Industrial and Systems Engineering Department, Georgia Institute of Technology, who was faculty advisor for the thesis.

TABLE OF CONTENTS

SUMMARY

The optimal layout and location of departments within a building has long been a problem confronting the building planner. This problem has been encountered in the hospital environment.

Delon and Smalley have carried out research in the use of computer programs to determine the location of departments within a hospital. The programs, CRAFT and CORELAP proved feasible but were restrictive in their capabilities; capable of laying out only one floor at a time.

The ALDEP (Automated Layout DEsign Program) developed by Dr. Seehof and Mr. Evans is similar in nature to the CRAFT and CORELAP programs. It relies upon input data composed of the desired departments, an activity relationship chart giving the desired relationships between departments, the square footages for each department, any predetermined area locations, and the overall dimensions for the building under consideration. The advantage of the ALDEP program is its ability to layout three floors at a time.

It was the intent of this thesis to apply the ALDEP program to a conceptual hospital design. Changes were introduced in the input data and the resulting changes reviewed. Following the application of ALDEP to the conceptual hospital it was applied to the Atlanta Eye Clinic and Hospital in Atlanta, Georgia and a comparison was made between the existing Atlanta Eye Clinic and the computer output.

The test applications showed that the ALDEP program used the input data properly, reacted well to changes in input, and did provide

sets of layouts showing the location and layout of the departments in the hospital under consideration.

CHAPTER I

INTRODUCTION

> Some of the increased costs of hospital services can be atributed to 'haphazard planning' of new hospital facilities ... average daily service charges by hospitals nationwide have increased 138 per cent from 1950 to 1963 compared with an increase of 59 per cent in total medical costs and 27 per cent in the overall cost of living during the same period ... an important reason for the rapid rise in the cost of hospital services has been the haphazard planning that has preceded the construction of acute general hospitals. (1)*

These comments were made by Marion B. Folsom, former Secretary of Health, Education, and Welfare during a speech in 1964.

Perhaps the increase in costs has been permitted by the public. The public has only a limited choice of whether or not to purchase the services of the medical profession. If a person needs medical attention he has two choices available to him: either he obtains medical treatment or he refuses the treatment. If he refuses the treatment he runs the risk of more illness, discomfort, and possible death. When someone is confronted with illness he will be more concerned with obtaining relief than with the expense involved.

It is imperative, with the staggering increase in hospital costs, that efforts be made to curb and/or reduce the cost of hospital services. In developing a hospital, the planning, as indicated by Mr. Folsom, may

---

*This and subsequent references are listed at the end of this thesis under "Literature Cited."

greatly affect the future costs of the hospital. Systematic planning is essential in order to achieve proper departmental location and layout. The location of various departments relative to one another within a building has long been a problem for the hospital building planner. This problem has not been limited solely to the location of a department on a given floor but also to its possible location on various floors. Poor location of departments can have many effects upon the investment in the building, the operational costs, and the flows of people and materials once the building is in operation.

The design and layout of a hospital has certainly not been free of the problems encountered by the building planner. Proper and suitable location of the operating suite, the radiology department, the central supply area, the emergency room and their proper relation to one another are extremely important in the hospital layout. Hospital design has often been determined by meetings of the planners with certain hospital administrative personnel in an attempt to relate departments, location, and layout on a strictly opinionated approach. Delon's and Smalley's work, Quantitative Methods for Evaluating Hospital Design (2) is in part based on the generation of design layouts through the application of certain computer programs, (CRAFT and CORELAP). While the results did produce various layouts, the computer programs used were limited to analyzing a single floor at a time. The CRAFT and CORELAP programs can only lay out one floor at a time and consequently will not consider any inter-floor relationships. The CORELAP program does not provide for the placement of specific areas in required locations.

It is the intent of this thesis to apply a methodology for the determination of the layout of the various departments within today's multi-story hospital environment. A conceptual hospital of a given size and with a certain number of predetermined departments has been developed. The conceptual hospital is a test hosiital. Changes were made in the input requirements and the resulting output was studied to determine whether any reactions occurred. Following tests for the conceptual hospital, and application of the methodology to an existing hospital was conducted and a comparison made between the computer output and the actual hospital layout.

CHAPTER II

LITERATURE SURVEY

There have been frequent magazine articles written concerning the design of specific departments within a specific hospital. Articles such as "Efficient Layout of the Radiology Department" (3), "Blueprint for a Professional Hospital Library" (4), and "Planning the Nursing Unit" (5) are plentiful. A review of several books dealing entirely with hospitals, their design, functions, and coordinated activities again provided many concepts for individual areas or units but none of the books attempted to provide an overall method or attack procedure for coordinating the total hospital design. These books examined included: Hospitals - Integrated Design by Isadore Rosenfield (6); Studies in the Functions and Design of Hospitals, by the Nuffield Provencial Hospitals Trust (7); Hospital Planning, by Charles Butler and Addison Erdman (8); Hospital Design and Function, by E. Todd Wheeler (9). The available literature had not, until recently, produced a methodology useful to designing hospitals wherein the various departments were coordinated with one another. Quantitative Methods for Evaluating Hospital Designs, by Delon and Smalley, provides a methodology for the overall analysis of departments within a hospital. The report is based partially on the CRAFT and CORELAP computer programs as methods to co-ordinate the overall design in a hospital. In this report, CRAFT and CORELAP are interrelated by having CORELAP's output used as CRAFT's input. Due to deficiencies inherent in the CRAFT

and CORELAP computer programs a significant deficiency existed in this methodology as explained in the next paragraphs.

The idea behind the CRAFT (Computerized Relative Allocation of Facilities Techniques)(10), computer program was developed in Zurich, around 1928, by Professor Dr. Walter F. Daenzer, Director, School of Industrial Engineering, Institute of Technology (E.T.H.).

The CRAFT program is restricted in that it can locate departments according to desired relationships on a specific floor but cannot consider locating a department at various floor levels.

CORELAP (COmputerized RElationship LAyout Planning)(11). does not require a predetermined building design for a great deal of freedom in design - a freedom that seldom exists in multi-story hospitals due to regulations concerning corridors, stairways, and elevators. A deficiency of the CORELAP program is its inability to allow the planner to locate specific areas at required locations in the design, i.e. departments, corridors, elevators, and stairs. Like CRAFT, CORELAP is also limited to the location of departments on one floor at a time, as opposed to multi-floor location. These deficiences significantly detract from the value of CRAFT and CORELAP as few hospitals will involve only a single floor. (The ALDEP program is limited to three floors: see Recommendations, page 35).

Plant layout is defined as:

> ... the preparation of schematics representing floor plans and templates for the equipment to be used as the principle method of layout. The analysis and design following this preparation is trial and error, i.e. the planner moves the templates around until some feasible fit is found satisfying a predetermined flow. (12)

If an attempt were made to provide a methodology for designing hospitals similar to what industry uses, a flow chart might first be considered, even though a flow chart is not necessarily the best approach. (13)

It is usually felt that industrial plants are designed for efficient and effective production of some product and this often necessitates a large capital investment in equipment; equipment which must be utilized to its fullest extent. In a plant, fairly definite flows can usually be predetermined. A hospital certainly has many characteristics similar to an industrial plant in the hospital's large capital investment and the need to achieve maximum utilization of equipment. The hospital has many flows which can be predetermined and are very useful in developing necessary relationships between departments and areas. There are times when unorthodox flows are created in the hospital by unforeseen circumstances, i.e. patient reaction to treatment, equipment needs, and emergencies. These conditions are fortunately limited in number.

Emphasis in industrial plants is placed on the most economical flow of materials as the basis for a layout arrangement.

> A flow pattern is determined and diagrammed and the rest of the activities are then fitted in and around that pattern. Actually, this is not the best practice as a general rule for layout procedure. Reasons for not basing a layout strictly on the flow of materials are readily available. It is necessary for the integration of supporting services into the flow in an organized manner. Yet there may be a given operation that is dangerous or dirty where it would not be desirable to locate this operation next to an area that must be kept clean even though it follows the flow sequence. (14)

Finally, in a service industry, like a hospital, real or definite flows will not always exist or be determinable where service activities are

involved. A systematic process for relating service activities to each other, and of integrating supporting services into the flow of material, is essential.

The activity relationship chart is an ideal technique for planning the relationship between any group of related activities. The activity relationship chart is similar to the "from-to" chart except that only one set of locations is indicated. (15)

> The relationship chart is a cross section form where the relationship between each activity (or function or area) and all other activities can be recorded. The relationship chart will show which activities have a relationship to others. Also, it will rate the importance of the closeness between them and will support the rating with coded back-up reasons. This gives us a rated and reason supported chart. These measures make the relationship chart one of the most highly practical and effective tools available for layout planning. It is undoubtedly the best way of integrating supporting services with the operating or producing departments and of planning the arrangement of office or service areas having little or no flow of materials. The word activity is a universal term, used ... to designate "things" (other than people and process material) which are being located as part of the layout planning. It will encompass, at different levels of planning or in different situations: departments, areas, functions, work centers, buildings, building features, machine groups, operations, and the like. (16)

There are several general methods for establishing the relationships between the activities on the activity relationship chart. These include the designer's knowledge of the project or related fields, calculations to determine relative closeness desired by the particular project, opinion surveys, general discussion sessions, or any combination of the above.

The hospital has diverse activities and operations, often complicated by availability, time, and emergencies which sometimes produce

uneven, unexpected, and sometimes undefinable flows. In planning, a hospital, being a service oriented enterprise, seems to offer an excellent opportunity for the application of an activity relationship chart.

In order to achieve the maximum value from an activity relationship chart, the value of each activity relationship must first be determined. After the activity relationship values have been determined and the activity relationship chart developed using these values, an effective and efficient method for evaluation of the activity relationship chart itself is needed. This evaluation will lead the user to the development of an optimal layout. Optimal, according to Webster's Dictionary, "satisfies all desired conditions perfectly" as opposed to optimum, which, "satisfies all conditions as closely as possible." (17). It is highly unlikely that an optimal layout will ever be achieved. Whether or not a layout is an optimum layout depends a great deal on human judgment. Opinions as to whether an optimum layout has been achieved may contrast widely among different analysts.

The ALDEP (Automated Layout DEsign Program) computer program developed by Dr. Jerrold M. Seehof and Wayne O. Evans uses an activity relationship chart to determine the location of departments within a building. The ALDEP program input requires an activity relationship chart, the overall building dimensions, and a listing of departments and required areas in square feet. (18) The ALDEP program allows the planner to specify the location of elevators or stairs, corridors, and any other departments or areas. In addition to this increased flexibility, the ALDEP program is adaptable to buildings of one to three separate floors at one time. Present ALDEP program design limits ALDEP to three

floors. The flexibility that is achieved, certainly allows the planner to more closely approximate normal planning conditions. It is unusual for a hospital to have only one floor and it is a great advantage to have a methodology that will provide layouts with corridors, elevators, and any other fixed areas which cannot be varied from floor to floor.

The output from the ALDEP program produced several layouts; the number of layouts may be altered. Each layout is individually scored by the computer.

> The layout score is the summation of the preference value (activity relationship value) for adjacent departments (referred to as "adjacent scoring"). For each square of the building, the preference value of the eight surrounding modules is added to the layout score. Then the preference value is set to zero so that it is included only once in the layout score. A special routine is included to score departments which are located across a corridor. Adjacent scoring was chosen to simplify the programming. The use of adjacent scoring is not a severe limitation since functionally dependent departments will tend to group together due to their combined interrelational preference values. (19)

The layouts with the highest scores more closely approximate the optimal layout. Personal judgment will determine which layout is optimum. While the ALDEP program may never provide the optimal layout, the great value of the program is its ability to produce a large number of different layouts in a short time. These layouts then become a helpful tool for the planner to use in developing the optimum layout.

There is a gap between what is available to the hospital planner and the resources he uses. There is no indication from the literature survey that computers have ever been used to plan an actual hospital. The use of the CRAFT and CORELAP computer programs by Delon and Smalley, indicated these computer programs to be useful tools to the hospital

planner. It is desired that this thesis will show that the ALDEP computer program is a useful tool in the hospital environment. The hospital planner will then have new and increased flexibility (to specify required area locations and multi-story location capabilities) in the techniques he has available to aid in the layout and design of a hospital.

CHAPTER III

COMPUTER EQUIPMENT

The ALDEP computer program, written in FORTRAN, was developed by Dr. Jerrold Seehof and Mr. Wayne Evans. The program is available from Mr. Evans at the International Business Machines Corporation in Rochester, Minnesota.

In order to compile and execute the ALDEP computer program, the minimum computer system necessary is an IBM System 360, model 40, with a minimum storage capacity of 128 K bytes. In addition, a floating-point option and a standard instruction set are required. It is also necessary to have at least one direct-access device for intermediate storage and a minimum 132 character print line printer.

The computer used for this research was an IBM 360, model 50, computer at the University of Georgia in Athens, Georgia.

CHAPTER IV

PROCEDURE

Objective

The primary objective of this thesis is to apply a methodology for the determination of the location and layout of the departments within a hospital. It is hoped that the methodology will reduce, if not eliminate, the massive problem in combinatorial topology which the architect and/or hospital planner faces when attempting to develop an optimal layout.

Ideally a number of possible scored layouts will be developed which will help guide the planner in developing the optimum layout for the given situation. These layouts should meet the medical as well as the most economic requirements of an effective and efficient hospital. It is also desired that the methodology will have sufficient flexibility within its scope to closely approximate conditions encountered in true life design. This is opposed to the traditional hit and miss methods in current use.

Hypothesis

A hypothesis, according to Webster's Dictionary is a

> ... proposition, condition, or principle which is assumed perhaps without belief in order to draw out its logical consequences and by this method test its accord with facts which are known or may be determined. (20)

The hypothesis for this thesis is:

> It can be shown by application that the use of the basic concepts of the ALDEP computer program are applicable for the optimal multi-story hospital design layout.

The concepts of the ALDEP program, with its increased flexibility in department and area location along with multi-story location, should prove feasible and add a new dimension to improved hospital design techniques.

Assumptions

The assumption for this thesis is:

> The activity relationship chart is a valid input in which the relation of one department to all other departments under consideration may be accurately depicted in the hospital environment.

The foregoing assumption is based on Muther's description of the activity relationship chart (see Literature Survey, page 7).

Limitations

The limitation for the use of ALDEP is:

> The ALDEP computer program is limited at the present time to handling a maximum of three floors and a total of sixty-three areas in a given layout. The ALDEP program can also be used laying out only one or two floors, depending upon the needs of the hospital under consideration.

Requirements

The requirements for the use of ALDEP are:

1 - The activity relationship chart must include the relationship of all departments and areas under consideration.

2 - The number of floors (up to three), the unlimited length and width of the design area, and any desired fixed locations of areas necessary to the hospital must be included in the computer program input.

Scope of the Procedure

In choosing the departments and areas to be used in the conceptual hospital, no restrictions will be imposed other than the limitation of a maximum of sixty-three areas. Up to that, addition and deletion of departments and areas at the designer's own discretion will be allowed. This will facilitate testing the application of the methodology to see if these alterations do in fact affect the layout and orientation of the facility. The purpose of the conceptual hospital is to make changes in the input requirements and study what effects these changes have on the output. After the methodology has been applied under the conceptual hospital conditions and if the application indicates the hypothesis to be true, the methodology will then be applied to an actual in-service hospital. The actual in-service hospital will dictate what departments or facilities will be needed and used in the input. The output for the actual in-service hospital will be compared to the existing facility.

The freedom of department and area selection is beneficial in showing that the methodology is not restricted to a particular type of hospital. This freedom of selection for departments and areas means that with a successful application of the methodology, it will be applicable not only to the big city general hospital, but also to the medical college hospital facilities and even to small rural county hospitals. The needs and goals of the above mentioned hospitals are varied. A methodology for layout and design of such facilities will be the result of this study.

The activity relationship chart for the conceptual hospital as well as the actual in-service hospital will be evaluated by the ALDEP computer program by a built-in scoring system within the computer program. After the various combinations of layouts have been developed by the computer, they are scored by the computer program relative to how well they comply with the desired relationships developed in the activity relationship chart. The higher the score, the more desireable is the layout (see literature survey, page 9, for score description).

It is not the researcher's objective (see page 12) to have an output that is precise and unalterable. It is desired that the output will provide the architect, hospital planner, and hospital administration with a set of working layouts. These layouts may be based on any number of different activity relationships and may be altered as desired to meet the goals and needs of a particular hospital.

CHAPTER V

METHOD OF PROCEDURE

In order to achieve the objective of this thesis of applying a methodology for the determination of location and layout of the various departments and areas within a hospital, and in order to plan an effective and efficient hospital, the following procedure will be used for the conceptual hospital:

1 - Determine which departments are to be used in the conceptual hospital.

2 - Collect data on the relationships between the various departments, determine the floor areas required for the departments, and synthesize a component variable activity relationship chart to meet the particular needs of the hospital. The data that are essential to perform the layout procedure are:

   a - The outside dimensions of the hospital.

   b - The departments to be incorporated (from step one).

   c - The corridors, stairs, and elevators to be used.

   d - The size of all departments and/or areas in square feet. This area represents the total area for a department; the usable floor space plus wall thickness.

(These data will be determined, in general, by the architect in an actual situation. The data will be based on the nature, size, and goals of the hospital under consideration. A hospital incorporating two and four patient rooms for one thousand patients will certainly have different demands than those of a hospital for two hundred patients; mostly in one and two patient rooms). The sizes of the area of the different departments are based on the regularly published architectural guides (such as Time-Saver Standards by McGraw-Hill) or on books by the U.S. Department of Health, Education, and Welfare (such as Medical School Facilities: Planning Considerations and Architectural Guide) (21). Once the required data has been ascertained, the activity relationship chart will be developed for the conceptual hospital by this researcher. This will be based on information and data from the U.S. Department of Health, Education, and Welfare, and the author's experience in working as an assistant hospital project engineer.

3 - Determine the number of floors and locate any fixed areas that might be desirable to the hospital.

4 - Determine the value to be used for each activity relationship used on the activity relationship chart.

5 - Run the ALDEP computer program with the necessary input data for a number of different relationships for the conceptual hospital.

6 - Review the output of the various layouts produced by the computer with the criteria based on the built in scoring system.

This review is necessary in view of the possibility that while a particular layout may be scored higher than another, the higher scored layout may possibly have one or more departments located in such a manner that they would be detrimental to the hospital's functioning properly.

7 - Determine the effectiveness of the computer program by interviewing architects and hospital planners to obtain their reaction to the final computer output.

A similar procedure will be used when applying the methodology to an actual in-service hospital.

The procedure will be applied to two layout plannings:

1 - One application will be the use of the conceptual hospital as described above.

2 - The second application of the methodology is to an actual in-service, three floor hospital where the computer output will be compared to the existing facility.

This comparison will allow for the application of the ALDEP computer program to reality. It would be desirable to apply the methodology under actual conditions where the methodology could be used coincident with the actual planning of a planned hospital. Time is a prohibitive factor that will not allow such an application. An actual in-service hospital seems to offer the next best area for applying the methodology to an actual situation. The hospital used for the in-service application is the Atlanta Eye Clinic and Hospital, 705 Juniper Street, N.E., in Atlanta, Georgia.

CHAPTER VI

RESULTS

One: Conceptual Hospital

Test Number One. To test the applicability of the ALDEP computer program the first step was to determine the departments and the necessary square footages needed for each department to be used in the conceptual hospital (see appendix, page 39). In the initial tests, each of thirty patient rooms was considered as a specific department. This restricted the use of other departments in the test because of the computer program limitation of sixty-three individual departments and/or areas.

The activity relationship chart (see appendix, page 48) was then developed based on the researcher's previous hospital experience. In the original ALDEP computer program, the preference values for the activity relationship chart were set as follows:

A, absolutely necessary = 64

E, especially important = 16

I, important = 4

O, ordinary closeness OK = 2

U, unimportant = 0

X, undesirable = -1024

The preference values are the values used by the computer program to score each layout. These values are arbitrary, and may be altered at the discretion of the user. Should the need to change the input preference

values arise, it is only necessary to change the values on a single card in the computer program deck. This change would be necessitated should a positive score not be achieved for the layouts under consideration (see test two).

The determination of the length and width of the hospital, the number of floors to be involved, and any particular fixed locations or areas was the next item in the procedure (for layout of general building floor plan; see appendix page 51). In order to utilize the maximum capacity of the ALDEP computer program, a three floor hospital was selected. To determine the length and width of the test hospital, the total area to be utilized by the departments (including wall space but excluding corridors, elevators, and stairs) was totaled. The total area was approximately 48,000 square feet, including wall space, of which one-third or 16,000 square feet was needed for patient room facilities; patient rooms, intensive care wards, nursing stations, and others. Because 16,000 square feet was needed for the patient departmental grouping, it was decided to use this area as the base area for each floor. With 16,000 square feet on each of three floors, 48,000 square feet was available for departmental placement; the total area needed as found above.

In order to incorporate enough area for elevators, stairs, main corridors, and halls, a multiplier of 1.5* was used to determine the

*Mr. Joseph N. Smith, Professor of Architecture, Georgia Institute of Technology, suggested 1.5 as it is recognized as an industry standard among architects.

gross floor space needed for each floor. By using the multiplier, the gross area per floor was 24,000 square feet or 72,000 square feet for the three floors (including wall space). When the actual length and width of the conceptual hospital was determined, it was found that by using a length of 170 feet and a width of 150 feet, an area of 25,500 square feet was provided. A rectangular shape closely approximating a square is desirable, as the square has the minimum dimensions necessary to provide a given area. When main corridors, elevators, and stairways were considered, they required:

main corridors	7,900 square feet
elevators	400 square feet
stairs	400 square feet
total	8,700

This total of 8,700 square feet does not exceed the assumed value of 9,500 square feet (25,000 - 16,000) and allows a buffer (unassigned) area of 800 square feet. It is essential to have a buffer area available on each floor to avoid the splitting of departments; the computer program will not split a department between floors. Should a buffer area not be provided, the possibility exists that the computer will not complete the necessary functions to print out feasible layouts.

The elevators were located in the central corridor with the stairs positioned to comply with the regulation that no point in the building be more than 100 feet from an exit stairway.

Certain fallacies exist in the proposed conceptual hospital's size and shape. The corridor locations are such that large, unobstructed areas

(free from corridors, stairways, and elevators) are not easily obtained. Certainly, in a hospital, such areas are needed for departments like the operating suite and the cafeteria. This proved to be a problem in later tests but it is believed to be a problem inherent in the concept of the shape of the conceptual hospital rather than a problem with the ALDEP computer program.

The first tests that were run did not provide any layouts even though the computer did evaluate several possible layout configurations. In order for the computer to accept a given layout, the score of the layout must be positive and equal to or greater than a minimum score input value (see literature survey, page 9, for score description). It is recommended to begin the initial computer tests with a minimum input value of zero. After a few layouts have been scored, a range of scores may be approximated. Once the range of scores has been approximated, a new minimum input value may be used. The minimum value makes it possible to eliminate those layouts with a low relative score from the print-out. The elimination of the low-score layouts is advantageous since these layouts will not have met the desired departmental relationships as well as the higher scored layouts. Consequently, these layouts will not approach the optimal layout as well as the higher scored layouts. As pointed out previously, the preference values are quite arbitrary. Because of this it is often necessary to alter the preference values in order to insure positive layout scores. In the first tests, it was found that due to the large negative value assigned to the X (undesirable) relationship, it was impossible to achieve a positive score for any given layout. Because of this, no layouts were accepted by the computer program during test number one.

Test Number Two. The second tests were more rewarding. A change was made in the activity relationship chart preference values in order to insure a positive score. The preference values were changed as follows:

A, absolutely necessary, from 64 to 99

E, especially important, remained at 16

I, important, remained at 4

O, ordinary closeness OK, from 2 to 1

U, unimportant, remained at 0

X, undesirable, from -1024 to -1 .

For this test, as in the first test, the patient-ward oriented departments were assigned to the third floor. The assignment of departments to particular floors may be used by the planner at his own discretion. Of 100 layouts examined at random, (the number of layouts to be examined by the computer is variable and may be changed by altering the input on one data input card) by the computer in approximately eight minutes of computer time, sixty-four of the layouts exceeded the minimum input score value of 400 (in this case) and were printed in the output (for a sample layout, see appendix, page 52).

In these tests, each patient room was listed as a separate department. In some instances, a patient room was split by a corridor. This is a condition which is not possible in any hospital. Having departments split across a corridor was prevalent in several cases, but it is felt that the methodology was not in error because the necessary relationships were met in most cases. This is in keeping with the objective of having a set of optimum working solutions for use by the hospital planner or architect. In those cases where all necessary relationships were not

met, but yet the score for the particular layout exceeded the minimum desired score, a statement was printed by the computer at the bottom of the print-out stating which department relationships had not been met.

Another problem that was found to exist was the isolating of a particular department along an outer wall or in one of the inner cores wherein easy access to a corridor did not exist. This condition was most prevalent in the small, insignificant departments like the shower for the patients and the linen closets. Again, it is still not believed that such a condition warrants deeming the methodology as being in error but rather in the concept of the shape of the hospital.

Test Number Three. For the third set of tests, two major changes were instituted in the data to be used. One change was to incorporate all of the patient rooms into two main departments: medical patient rooms and surgical patient rooms (for listing of combined patient room departments and department numbers, see appendix, page 55). The consolidation of patient rooms was done to reduce the number of departments occurring where the department was split across a corridor. The second major change was to withdraw the floor assignments previously used in the second tests to locate (specify floor) the patient-ward oriented departments from the data input.

The third series of tests were productive. The number of split departments was reduced, as was expected in the consolidation of patient rooms. The problem of isolated departments continued to persist but not to a significant degree (for sample layout of test three, see appendix, page 57).

The location of the nursing station relative to the patient rooms was poor, often being located on a separate floor, a condition which would be intolerable in a regular hospital. It is felt that this condition was caused when the floor assignments for the patient-ward oriented departments were eliminated and a change in the activity relationship values for the activity relationship chart was not instituted to compensate for the removal of the floor assignments (activity relationship chart for the third test, see appendix page 60). Initially, under the floor assignments, it was sufficient to have an "ordinary closeness" relationship value between the nursing station and the patient rooms. With the floor assignments removed and compensation on the activity relationship chart values not considered, the nursing station, under "ordinary closeness" to the patient rooms, could be located almost anywhere in relation to the patient rooms; including a different floor. With a suitable change in the activity relationship chart values, the firming-up of the necessary relationships between areas like the nursing station and the patient rooms, should eliminate the wide separation condition. In other respects the ALDEP computer program functioned as expected and desired.

The concept of the "buffer space" presented a condition which is questionable in the layout print outs. The ALDEP computer program instructions call for the beginning of the department location of the layout in the upper left hand corner of the floor plan. This has caused the buffer area to be concentrated in the lower right hand corner as the layout is developed from left to right. While the buffer area is not large, it does produce a building that is slightly off-center. An attempt was made

to change the position for beginning the layout from the upper left corner to a position in the top-middle of the floor plan. This attempt was made during Test Number Three. It was found that the computer placed a buffer unit every fourth block and that the departments were scattered and interspersed one with the other; a condition that would offer no feasible solution layouts (see appendix, page 62). In addition, only one layout was printed out as the dispersing of the buffer area made it impossible to have enough whole-area segments to place all of the departments in the layout. This was just the opposite of what was supposed to be eliminated through the use of the buffer area. In reviewing the instructions for the computer program, the input must designate that the layout begin in the upper left corner of the layout. This offers a possible area for future study; to find a way to eliminate the buffer area from being concentrated in a particular, confined area.

In order to continue with the steps outlined in the procedure, an interview was conducted with Mr. Edward Wundrum, architect with Heery and Heery of Atlanta, Georgia. Mr. Wundrum, after reviewing the results, was much in favor of the methodology. Mr. Wundrum offered some ideas for other applications of the methodology and they are given in the recommendations. Mr. Wundrum expressed the opinion that the concern previously exhibited over the splitting of departments was a "minor" problem that could be easily overcome; that it was more important to obtain the necessary location relationship between departments than to worry about a few square feet on the other side of a corridor.

Test Number Four. The fourth and final conceptual test was run with a revised activity relationship chart developed to give more emphasis to the necessary relationships among the patient-ward oriented departments (see appendix, page 65). The computer produced two-hundred layouts (at random), accepting forty-four layouts in a computer time of twelve minutes.

None of the layouts printed (for sample layout, see appendix, page 66) met all of the desired relationships. The main cause was not being able to locate the blood bank and/or the on-call quarters adjacent to the operating suite. The location of the departments in question was on the same floor, anywhere from ten to fifty feet from each other. This small separation distance is not considered significant.

Summary of the Changes Initiated in the Conceptual Hospital and Consequent Reactions

Test Number One:

Changes: None, no layouts produced due to large negative value input for undesirable relationships.

Test Number Two:

Changes: Activity relationship chart preference values revised from:

A = 64	to	A = 99
E = 16	to	E = 16
I = 4	to	I = 4
O = 2	to	O = 1
U = 0	to	U = 0
X = -1024	to	X = -1

in order to insure a positive layout score.

Reaction: Output achieved. Computer evaluated 100 layouts, printed out 64.

Problem Areas: 1- Several areas split across a corridor but desired relationships with other areas still maintained.

2- Isolation of areas such that they were not easily accessible.

3- Buffer area concentrated in lower right-hand corner of layout.

Test Number Three:

Changes 1- All of the patient rooms incorporated into two departments: medical patient rooms and surgical patient rooms.

Reaction: Consolidation of patient rooms eliminated many of the areas being split across a corridor.

Change 2- Specific floor assignments for the patient-ward oriented departments was removed.

Reaction: The location of the nursing station relative to the related patient rooms was poor, often on separate floors. This was caused by not making an adjustment in the activity relationship chart values to compensate for the elimination of the floor assignments.

Change 3- An attempt was made to spread the buffer area throughout the layout in order to eliminate the concentration of the buffer area in the lower right-hand corner. This was done by attempting to start the design in the top middle of the layout.

Reaction: A buffer unit was placed every fourth area unit and the departments were scattered. A review of the ALDEP

instructions indicated the design must start in the upper left-hand corner.

Problem Areas: Poor location of the nursing station and related patient rooms.

Test Number Four:

Changes: The activity relationship chart was revised to give more emphasis to the nursing station-patient ward areas.

Reaction: The desired relationship was achieved in the output.

Problem Areas: In the final tests the blood bank and/or the on-call quarters were not located adjacent to the operating suite as desired. This was considered insignificant as the distance between these departments and the operating suite was never more than fifty feet and as close as ten feet.

Two: Actual In-Service Hospital - Atlanta Eye Clinic and Hospital

The second phase was to use an actual, in-service, three floor hospital where facts and data can be collected, the computer program run, and the output compared to the existing facility. The reason for this phase of testing was to apply the methodology to a real life situation. The Atlanta Eye Clinic and Hospital was chosen for this portion of the procedure.

Mr. Redding, administrator for the hospital, provided the floor plans of the hospital and the departments and size of each department was determined from the plans (see appendix, page 69). In an interview with Mr. Redding, the desired optimum relationships between the departments in the hospital (see appendix, page 71), were obtained after the

hospital was in use for three years. An activity relationship chart was then developed for the relationships as desired by Mr. Redding (see appendix, page 72). This information, along with the departments, department areas and the floor plans (see appendix, page 73), was then input into the computer and the program run. The computer checked at random two hundred possible layouts, printing thirty-nine in a computer time of nine minutes.

None of the actual layouts accepted by the computer met all of the needed relationships. One of the layouts, (run number fifty, see appendix, page 79) had the highest score but it could also be considered a poor layout because it did not locate the nurse's station close enough to the patient rooms. This was the only questionable relationship even though it did locate one of the patient floor groupings on the first floor of the hospital. Another layout with a lower score, did not meet the desired relationship between the nurse's station and the patient rooms. But it did locate the patient rooms on the second and third floors of the hospital as was more desirable. This proves that one should not consider the layout with the highest score necessarily to be the best layout in considering all requirements. Other layouts produced by the computer may possibly be more optimum than the highest-scored layout. (See appendix, page 82).

Certain undesirable relationships presently exist at the Atlanta Eye Clinic. These relationships are not desired by the administration and were put into the computer as undesirable. These are changes which the administration required due to practical experience:

1 - The administrators office is too close to the clinic.

2 - The administrator's office is too close to the waiting room.

3 - The waiting room on the third floor is too close to the operating suite.

4 - The X-ray department is separated by a floor from the minor surgery department. Close proximity is desired.

5 - The oxygen and anesthesia storage was on a different floor from the operating suite. Close proximity is desired.

All of these undesirable relationships were eliminated on the ALDEP layout with the highest score.

It is felt that the following reasons explain the inability of the computer program to provide a layout that could meet all of the desired relationships:

1 - The floor plans and corridor locations cannot be changed and are located in the wrong spots.

2 - The available floor space on a particular floor is not adequate to meet the requested floor space now required by the administrator.

3 - Some of the desired "close" relationships represent a personal opinion but could be altered, i.e., nurse's station - nurse's lounge and the clinic waiting room - receptionist.

Summary of the Actual In-Service Hospital (Atlanta Eye Clinic and Hospital) Application

Relationships desired but not achieved on the highest scored ALDEP layout:

1 - Nurse's station not close enough to the patient rooms.

2 - One patient floor grouping was located on the first floor of the hospital.

3 - Nurse's station not close enough to the nurse's lounge.

4 - Clinic waiting room not close enough to the receptionist (P.B.X.).

5 - Nurse's station not close enough to the elevator.

Undesirable relationships presently existing but eliminated in the highest scored ALDEP layout:

1 - The administrator's office too close to the clinic.

2 - The administrator's office too close to the waiting room.

3 - The waiting room on the third floor - too close to the operating suite.

4 - The X-ray department separated by a floor from the minor surgery department.

5 - The oxygen and anesthesia storage on a different floor from the operating suite.

Comparison of the ALDEP Layout to the Actual Atlanta Eye Clinic and Hospital Layout

It is the judgment of the analyst, using the preceeding summary, that will determine which of the layouts for the Atlanta Eye Clinic and Hospital (the ALDEP layout or the actual layout) is optimum. A diagram for the layout of each floor is given in the appendix, page 73, for both the ALDEP configuration and the actual, existing floor configuration.

CHAPTER VII

CONCLUSIONS

The ALDEP computer program was tested several times and the program ran without error. The following conclusions were ascertained:

1 - The departmental relationships, along with the area requirements for the specific departments which went together to determine the input data, were successfully used by the computer program to produce a set of feasible, working layouts for the conceptual hospital with very few adjustments.

2 - The ability to assign certain departments and areas to specific locations in the layout was confirmed with two layout considerations. The location of the elevators, stairs, and corridors was exact in all of the tests. The assignment of the patient-ward oriented departments in the second test was executed without error.

3 - The results of the application relative to the overall thesis objective of applying (positively or negatively) the methodology as a means of providing the architect or hospital planner with a number of working solutions was considered "positive" by Mr. Edward Wundrum. Mr. Wundrum is an architect with several years of experience, including extensive work in the area of medical facilities.

The test applications show that the ALDEP computer program, given the input data of:

1 - The desired activity relationship values.

2 - An activity relationship chart developed from the preceding values.

3 - The necessary area requirements for each department involved.

4 - Any specific predetermined department or area locations.

5 - The outside dimensions for the hospital in question.

does, indeed, provide sets of working layouts with the necessary departmental relationships attained. The results of the tests indicate that the methodology, herein applied, does meet the objectives of this thesis and consequently, the hypothesis, as stated, is true.

CHAPTER VIII

RECOMMENDATIONS

The application of the ALDEP computer program methodology presented some possible new areas of research in conjunction with the computer program; some using the program as it is presently written and others where alterations to the computer program could provide an improved methodology.

One possible consideration for extending the value of the present ALDEP program would be to apply the methodology to different floor plans. The concept of the shape of the hospital could have a distinct effect on the capability of the computer to provide adequate layouts. New shapes and floor plans may be easily evaluated through the use of the ALDEP computer program methodology.

Research into possible alterations in the ALDEP computer program also offers areas for study. At present, the capacity of the computer program limits its use to a maximum of three floors in a building. This limitation did not hinder the applications for the purpose of this thesis, but if the program could be expended to handle more floors it would offer greater variability and more areas for application. An attempt might also be made to spread the "buffer area" throughout the layouts as opposed to the present concentration of the "buffer area" in one corner.

The present ALDEP computer program requires that the general floor plan for the building under consideration be rectangular in shape. It is easily recognized that this is a highly restrictive condition as not

all buildings are rectangular in shape. If the program could be altered to accommodate various floor plan shapes, much greater variability could be added. It is possible to work around the "rectangular shape" restriction for a non-rectangular shaped building. This could be done by expanding the outer dimensions of the non-rectangular shaped building to form a rectangle. A "dummy department" could then be assigned to occupy the new area developed in expanding the outer dimensions. This would eliminate the possibility of any of the actual departments being located in an area that was not part of the actual building.

Development of a minimum departmental dimension for the program would be helpful and would probably tend to eliminate some of the splitting of departments that was encountered. This would also eliminate a department being fifty feet long and five feet wide, a width dimension that would be difficult, if not impossible to use effectively or efficiently.

A relationship that was not taken into account, but one that should be considered in the relating of the different departments to the "circulation system" of the building and also to the exterior of the building. This should eliminate the "isolation" of some departments away from corridors. It should also make sure that departments like the emergency room and purchasing/storage would have immediate access to the entrance/exits of the building and would not be "isolated" in an inner core section of the building. These considerations would be restrictions to the reasoning used in developing the activity relationship chart. Other considerations useful in the make-up of various

activity relationship charts would be a physical versus non-physical relationship and also a consideration for the extent communications may interact with the departments. Another consideration would be material handling problems and how they might be encountered.

The final recommendation is from Mr. Wundrum; that is, to apply this methodology to other real life situations and needs. These could include campus planning, manufacturing plant layouts and office complex personnel location.

APPENDIX

DEPARTMENTS AND AREAS

The following list of departments and areas have been compiled for consideration in the conceptual test hospital. The activity relationship chart will be constructed to include these departments and areas.

1 - Administrative offices (including business office)

2 - Admissions office

3 - Waiting room: Admissions office

4 - Outpatient department and waiting room

5 - Emergency room and waiting room

6 - Radiology department

7 - Operating rooms (including necessary office and supply areas)

8 - Recovery room

9 - Cafeteria (hospital personnel, patients, visitors)

10 - Central supply service

11 - Pharmacy

12 - Pathology (including morgue and autopsy)

13 - Nursing service office

14 - Medical records

15 - Housekeeping and maintenence

16 - Purchasing and storage

17 - On-call quarters (doctors and nurses)

18 - Doctors offices

19 - Waste disposal room

20 - Blood bank

21 - Surgery service patient rooms; fifteen two man rooms

22 - Medicine service patient rooms; fifteen two man rooms

23 - Nursing station and medicine room for surgery service

24 - Nursing station and medicine room for medicine service

25 - Linen closet; surgery service

26 - Linen closet; medicine service

27 - Patient shower and tub room; surgery service

28 - Patient shower and tub room; medicine service

29 - Kitchen facility (small); surgery service

30 - Kitchen facility (small); medicine service

31 - Nurse conference and rest room; surgery service

32 - Nurse conference and rest room; medicine service

33 - Doctors conference and rest room; surgery service

34 - Doctors conference and rest room; medicine service

35 - Visiting room; surgery service

36 - Visiting room; medicine service

37 - Intensive care: 4 single rooms; surgery service

38 - Intensive care: 4 single rooms; medicine service

39 - Dirty linen chute; surgery service

40 - Dirty linen chute; medicine service

There are other departments and areas that could be considered, but it is felt that these departments will offer a sufficient number of departments in order to test and evaluate the ALDEP computer program and judge whether or not the necessary relation between departments is achieved in the output.

TENTATIVE SQUARE FOOTAGES FOR DEPARTMENTS

Initial Tests - One & Two

Comp Code	Dept Code	Department	Sq Foot
1	110	Admin. office and Medical Records	3800
2	120	Admissions and Waiting Room	1750
3	130	Outpatient Department and Waiting Room	2600
4	140	Emergency Room and Waiting Room	2100
5	150	Radiology	1000
6	160	Operating Room, Recovery Room and Offices and Supplies	4000
7	170	Cafeteria (Hospital Personnel, patients and Visitors)	5000
8	180	Central Supply	2500
9	190	Pharmacy	300
10	200	Pathology (Including Morgue and Autopsy)	500
11	210	Nursing Service and Doctors Office	3500
12	220	Housekeeping, Maintenance, and Waste Disposal	600
13	230	Purchasing and Storage	1500
14	240	On-call Quarters (doctors and nurses)	1600
15	250	Blood Bank	1500
16	260	Nursing Station and Medicine Room Surgery Division	450
17	270	Nursing Station and Medicine Room Medicine Division	450
18	280	Linen Closet: Surgery Division	100

Comp Code	Dept Code	Department	Sq Foot
19	290	Linen Closet: Medicine Division	100
20	300	Shower: Surgery Division	250
21	310	Shower: Medicine Division	250
22	320	Kitchen Facility: Surgery Division	150
23	330	Kitchen Facility: Medicine Division	150
24	340	Nurse Conference and Rest Room: Surgery Division	500
25	350	Nurse Conference and Rest Room: Medicine Division	500
26	360	Doctors Conference and Rest Room: Surgery	500
27	370	Doctors Conference and Rest Room: Medicine	500
28	380	Visiting Room: Surgery Division	600
29	390	Visiting Room: Medicine Division	600
30	400	Dirty Linen Chute: Surgery Division	50
31	410	Dirty Linen Chute: Medicine Division	50
32	420	Surgical patient (2 man) Room	300
33	430	" " " "	300
34	440	" " " "	300
35	450	" " " "	300
36	460	" " " "	300
37	470	" " " "	300
38	480	" " " "	300
39	490	" " " "	300
40	500	" " " "	300
41	510	" " " "	300
42	520	" " " "	300

Comp Code	Dept Code	Department	Sq Foot
43	530	Surgical Patient (2 man) Room	300
44	540	" " " "	300
45	550	" " " "	300
46	560	" " " "	300
47	570	Surgical Intensive Care 4 - One Man Rooms	900
48	580	Medical Patient (2 man) Room	300
49	590	" " " "	300
50	600	" " " "	300
51	610	" " " "	300
52	620	" " " "	300
53	630	" " " "	300
54	640	" " " "	300
55	650	" " " "	300
56	660	" " " "	300
57	670	" " " "	300
58	680	" " " "	300
59	690	" " " "	300
60	700	" " " "	300
61	710	" " " "	300
62	720	" " " "	300
63	730	Medical Intensive Care 4- One Man Rooms	900

DETERMINATION OF DEPARTMENT SQUARE FOOTAGES

Department		Total Square Feet
Administrative Offices and Medical Records		3800 [1]
Administration	1200	
Business Office	1200	
Medical Records	1400	
Admissions and Waiting Room		1750 [1]
Admissions Office-Business	1250	
Waiting Room	250	
Admitting Area	250	
Outpatient Department and Waiting Room		2600 [2]
Outpatient Clinics	2000	
Outpatient Waiting Room	400	
Outpatient Business Office	200	
Emergency Room and Waiting Room		2100 [2]
Emergency Rooms: 4 @ 300	1200	
Waiting Room	300	
Reception Area	150	
Examining Rooms: 4 @ 150	450	
Radiology		1000 [1]
Office	200	
Waiting Room	200	
Laboratory and X-Ray	600	
Operating Room, Recovery Room, and Offices		4000 [2]
Operating Rooms: 6 @ 400	2400	
Recovery Beds: 8 @ 120	960	
Supply Area	140	
Waiting Area for Patients	200	
Nurse's Station	100	
Doctor's Office	200	

Department		Total Square Feet
Cafeteria		5000 [1]
Food Production	1600	
Seating Area and Service	2000	
Storage and Office Space	1400	
Central Supply		2500 [2]
Office	300	
Cleaning and Sterilization	1200	
Storage	1000	
Pharmacy (Dispensing and Small Preparation)		300 [2]
Storage and Small Preparation	200	
Office	100	
Pathology		500 [2]
Autopsy	150	
Morgue	250	
Office	100	
Nursing Service and Doctor's Offices		3500 [2]
Nurses Offices (Including Conference Room)	1750	
Doctor's Offices (Including Conference Room)	1750	
Housekeeping, Maintenence and Waste Disposal		600 [2]
Housekeeping	150	
Maintenence	350	
Waste Disposal	100	
Purchasing and Storage		1500 [2]
Office	150	
Storage	1350	
On-Call Quarters (Doctors and Nurses)		1600 [2]
Nurse's Lounge	200	
Nurse's Bed Room: 6 @ 100	600	
Doctor's Lounge	200	
Doctor's Bed Rooms: 6 @ 100	100	

Department			Total Square Feet	
Blood Bank			1500	2
Office	200			
Waiting Room	200			
Storage and Laboratory	600			
Donor Interview and Collection	500			
Nursing Station and Medicine Room: Patient Floor			450	2
Nursing Station	400			
Medicine Room	50			
Linen Closets: Patient Floor			100	2
Shower: Patient Floor			250	2
Shower-baths: 2 @ 100	200			
Sit Bath: 1 @ 50	50			
Kitchen Facility: Patient Floor			150	2
Nurse's Conference and Rest Room: Patient Floor			500	2
Conference Room	350			
Rest Room and Lounge	150			
Doctor's Conference and Rest Room: Patient Floor			500	2
Conference Room	400			
Rest Room	100			
Visiting Room: Patient Floor			600	1
Dirty Linen Closet			50	2
Patient Rooms: Two-man Rooms		Each Room	300	1
Intensive Care Rooms: One-man Rooms		Each Room	225	2

1. These areas are based on information obtained from the Medical Education Facilities - Planning Considerations and Architectural Guide by the U.S. Department of Health, Education and Welfare.

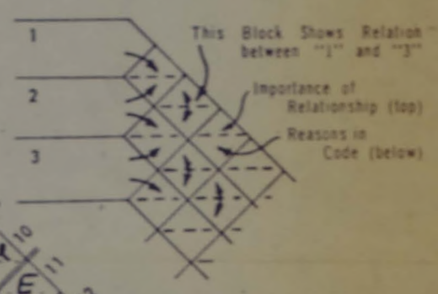
2. These areas are based on the researcher's own experience at both the Eugene Talmadge Memorial Hospital in Augusta, Georgia, and the South Fulton Hospital in Atlanta, Georgia.

The breakdown of the specific departments and areas could, in many cases, be expanded to include each and every minute area within a particular department. This was not undertaken as this would lead to definition of exactly what individual areas go into the make-up of a complete department and this is not one of the objectives of this thesis.

In some cases, for ease of manipulation, areas were rounded off to the nearest fifty square feet. There are certain areas where some people might contest the actual validity of the square footages prescribed. Since only sixty beds are involved in the patient areas, making the hospital relatively small, this makes the service areas seem out of proportion. This condition is caused by the limitation of the computer being able to handle only three floors at a time. Because of this, only one floor was designated for patients and it should be realized that in most all hospitals, patient floors are stacked one on top of the other and with few exceptions are identical in the actual floor plan. In essence then, when the methodology provides the layout for one floor, it is actually providing a layout for as many floors as we desire for the hospital. This is subject to certain architectural codes determining when, for structural reasons, the floor plan must be altered. This then allows for the service areas to be seemingly out of proportion relative to the patient areas.

Again, it is the object of the thesis to apply the methodology with respect to location and layout of the hospital relative to the activity relationship chart and not the exactness of the departments used or the square footages for each department.

Reference _____



1	ADMINISTRATION & MEDICAL RECORDS	110
2	ADMISSIONS & WAITING ROOM	120
3	OUTPATIENT DEPT & WAITING ROOM	130
4	EMERGENCY ROOM & WAITING ROOM	140
5	RADIOLOGY	150
6	OPERATING SUITE & RECOVERY ROOM	160
7	CAFETERIA	170
8	CENTRAL SUPPLY	180
9	PHARMACY	190
10	PATHOLOGY	200
11	NURSING SERVICE & DOCTOR'S OFFICE	210
12	HOUSEKEEPING & MAINTENENCE	220
13	PURCHASING & STORAGE	230
14	ON-CALL QTRS NURSE & DOCTOR	240
15	BLOOD BANK	250
16	NURSE STATION SURGERY DIV	260
17	NURSE STATION MEDICINE DIV	270
18	LINEN CLOSET SURGERY DIV	280
19	LINEN CLOSET MEDICINE DIV	290
20	SHOWER SURGERY DIV	300
1	SHOWER MEDICINE DIV	310
2	KITCHEN SURGERY DIV	320
3	KITCHEN MEDICINE DIV	330
4	NURSE CONF & REST ROOM: SURG	340
5	NURSE CONF & REST ROOM: MED	350
6	DOCTOR CONF & REST ROOM SURG	360
7	DOCTOR CONF & REST ROOM MED	370
8	VISITING ROOM SURGICAL DIV	380
9	VISITING ROOM MEDICING DIV	390
10	DIRTY LINEN SURGICAL DIV	400
11	DIRTY LINEN MEDICING DIV	410
12	SURGICAL PATIENT ROOM #1	420
13	SPR #2	430
14	SPR #3	440
15	SPR #4	450
16	SPR #5	460
17	SPR #6	470
18	SPR #7	480
19	SPR #8	490
20	SPR #9	500
1	SPR #10	510
2	SPR #11	520
3	SPR #12	530
4	SPR #13	540
5	SPR #14	550
6	SPR #15	560
7	SURGICAL INTENSIVE CARE 4 SINGLE ROOMS	570
8	MEDICAL PATIENT Room #1	580
9	MPR #2	590
10	MPR #3	600
11	MPR #4	610
12	MPR #5	620
13	MPR #6	630
14	MPR #7	640
15	MPR #8	650
16	MPR #9	660
17	MPR #10	670
18	MPR #11	680
19	MPR #12	690
20	MPR #13	700
16	MPR #14	710
17	MPR #15	720
18	MEDICAL INTENSIVE CARE 4 SINGLE ROOMS	730
19		
20		

Value	CLOSENESS
A	Absolutely Necessary
E	Especially Important
I	Important
O	Ordinary Closeness OK
U	Unimportant
X	Undesirable

"Closeness" Rating

Code	REASON
1	
2	
3	
4	
5	
6	
7	
8	
9	

Reasons behind the "Closeness" Value

TEST #1 VALUE SCORE

64
16
4
2
0
-1028

TEST #2

A = 99
E = 64
I = 4
O = 1
U = 0
X = -1

ACTIVITY RELATIONSHIP CHART

Tests 1 and 2

The Activity Relationship Chart was developed solely from the researcher's experience at the Eugene Talmadge Memorial Hospital and the South Fulton Hospital.

The activity relationship chart for test 1 and test 2 is quite bulky due to each individual patient room being considered an individual department. The symbols A, E, I, O, U, and X and their numerical value are explained on the chart.

Certain relations that stand out on the patient-ward oriented departments are the need for the nursing station of a particular service to be "absolutely necessary" to the intensive care area of the same service and for the separation of the medicine and surgery services. During tests 1 and 2, all of the patient-ward oriented departments were assigned to the third floor. This actually meant that the computer was dealing with two separate layouts; a one-floor patient-ward oriented layout and a two-floor hospital services layout.

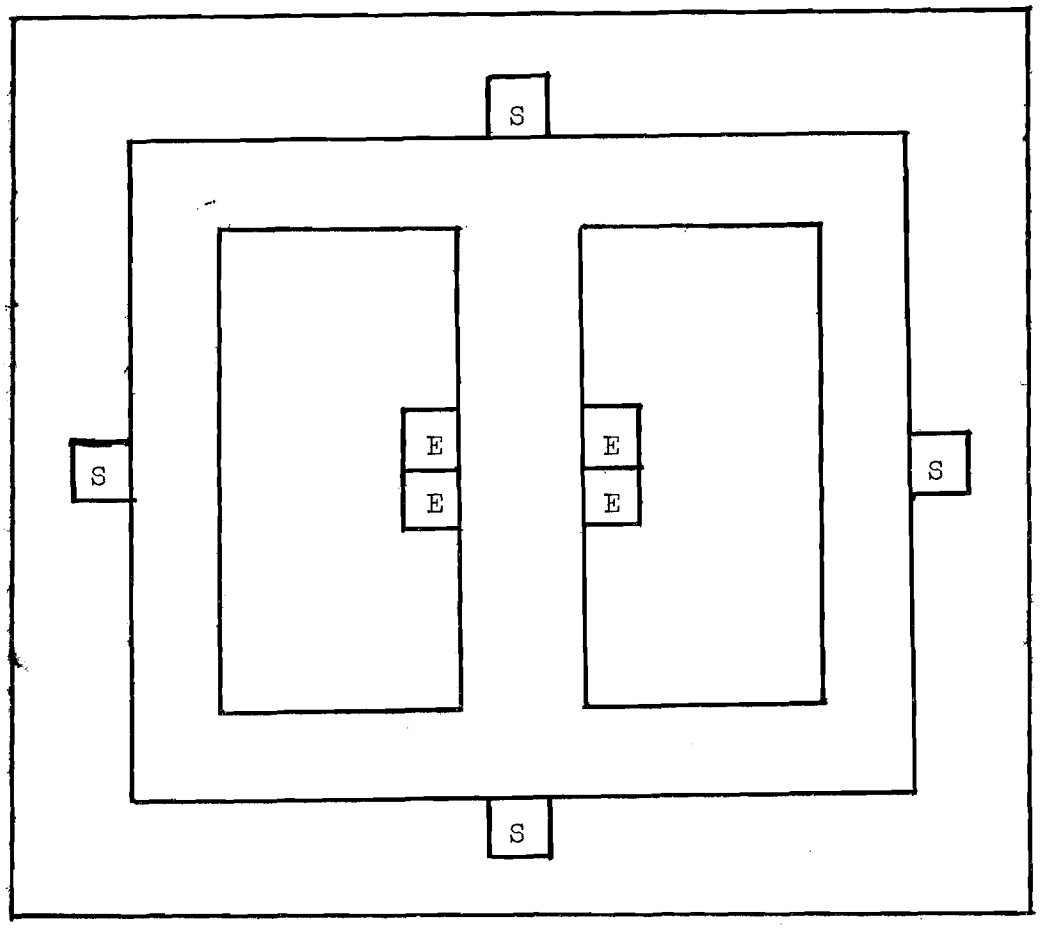
For the services oriented departments, the operating room was "absolutely necessary" to be near the blood bank and the on-call quarters for the doctors and nurses. The emergency room was "absolutely necessary" to be near the blood bank. These are examples of some of the departments needing a close relationship while the housekeeping-maintenence-waste disposal department was considered "undesirable" in location near the operating room, emergency room, blood bank, and the out-patient department.

Certainly, many of these relationships may be altered due to the nature, needs and goals of the hospital; some of these changes are instituted in a later test. One of the most obvious contrasts that would be made among hospitals would be the need for the emergency room to be located near the operating room in a hospital handling a large number of the city's emergency cases. Contrast this with the small town or county hospital that has few emergencies and would not be worried about having the emergency room next to the operating room.

A review of the print-outs shows that the computer is providing the necessary relationships with few exceptions. The relationship most commonly missed (28 out of 64 layouts) was being able to meet the "absolutely necessary" relationship between the operating room and the blood bank. In not meeting the relationship, the two departments were still close to one another, they just were not adjacent to one another. Overall, the methodology provided print-outs that fulfilled the necessary relationship as input on the activity relationship chart (32 out of 64 layouts or 50% met all requirements of the activity relationship chart).

CONCEPTUAL TEST HOSPITAL

GENERAL BUILDING FLOOR PLAN



Square footage requirements:

Floor Space (approx)	16,000
Corridor	7,900
Elevators	400
Stairs	400
Buffer (approx)	800
Total	25,500

Symbols:

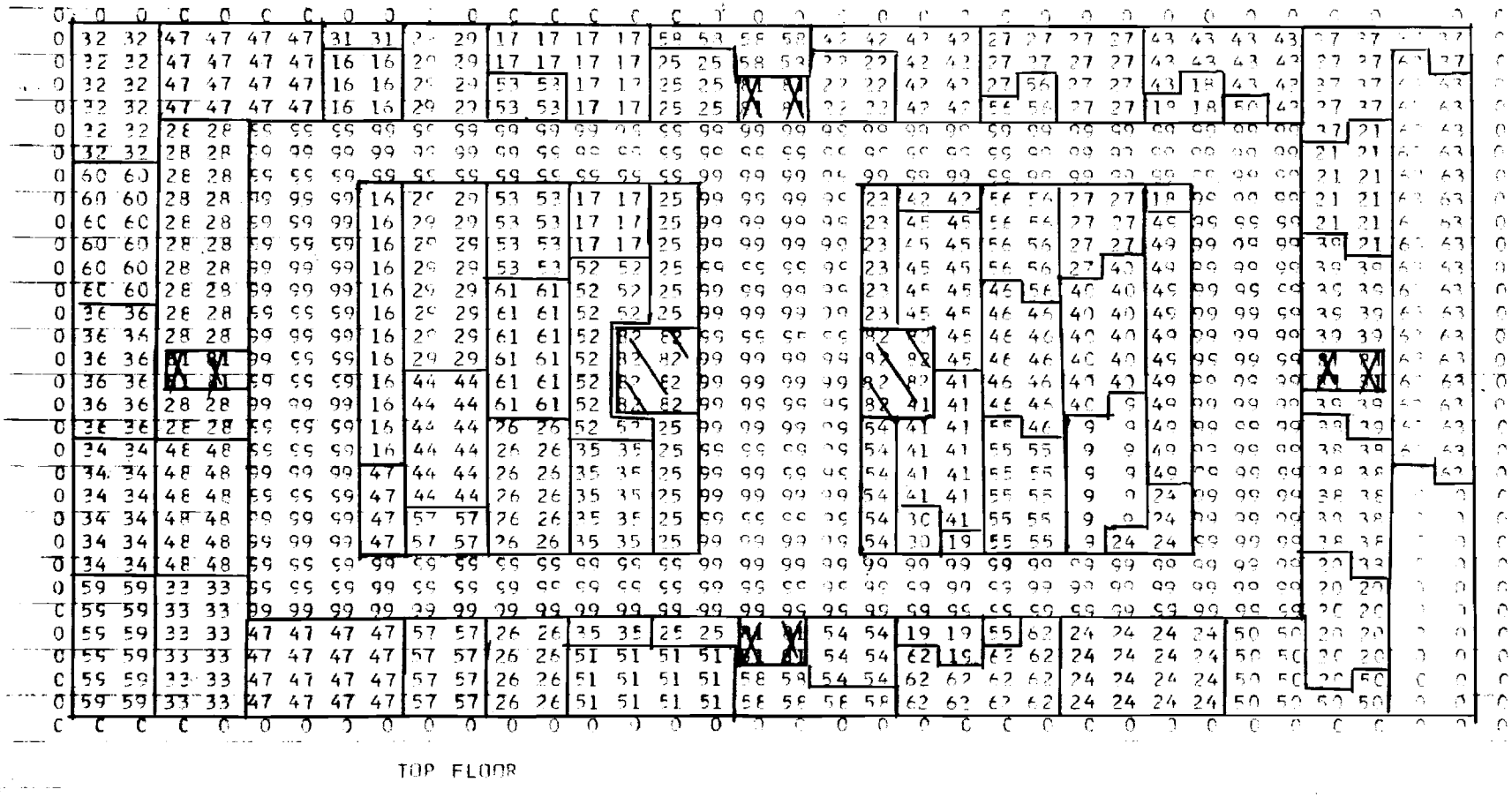
E: Elevators

S: Stairs

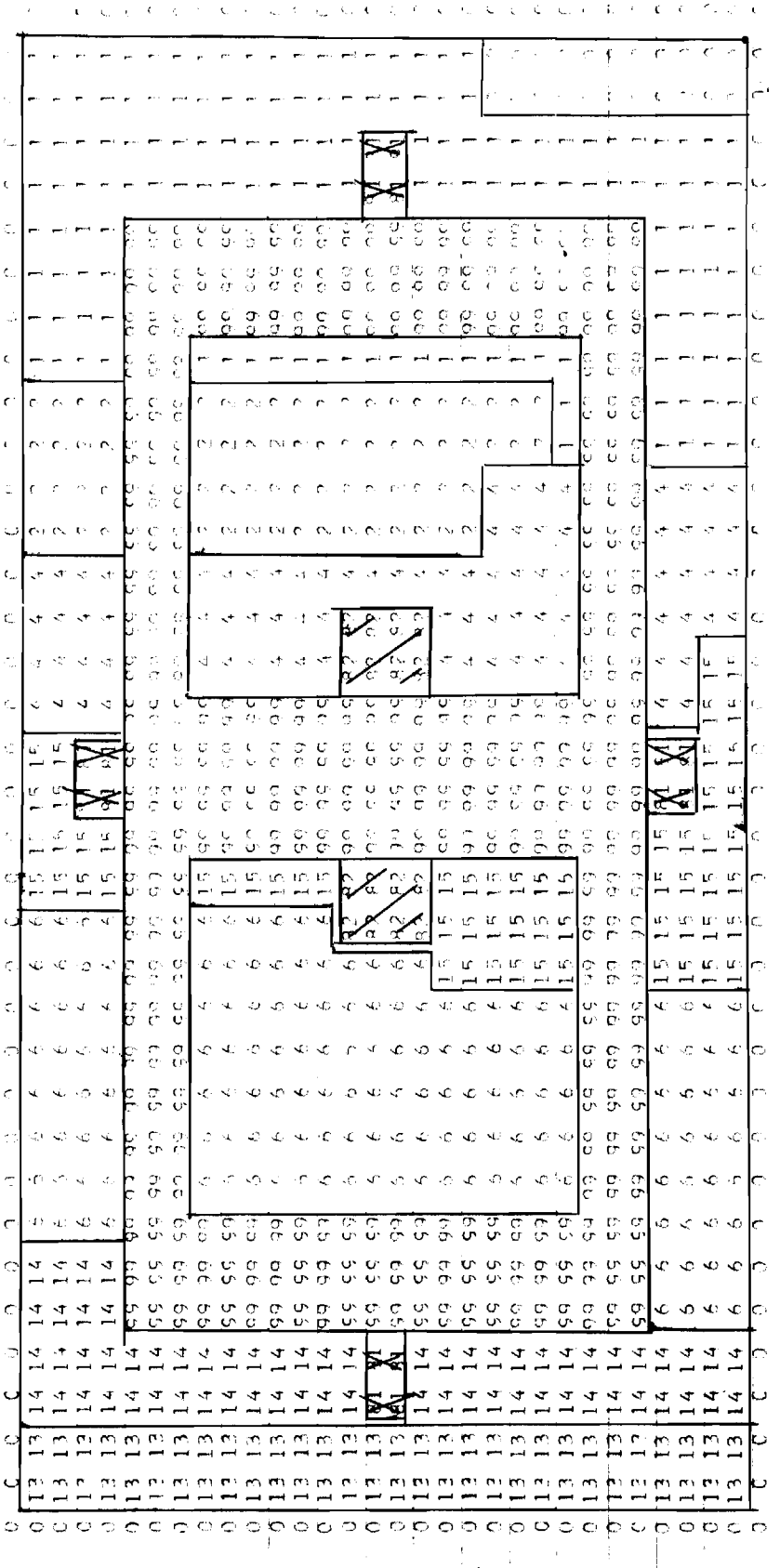
TEST 2

TRIAL LAYOUT 1004 SCORE = 499

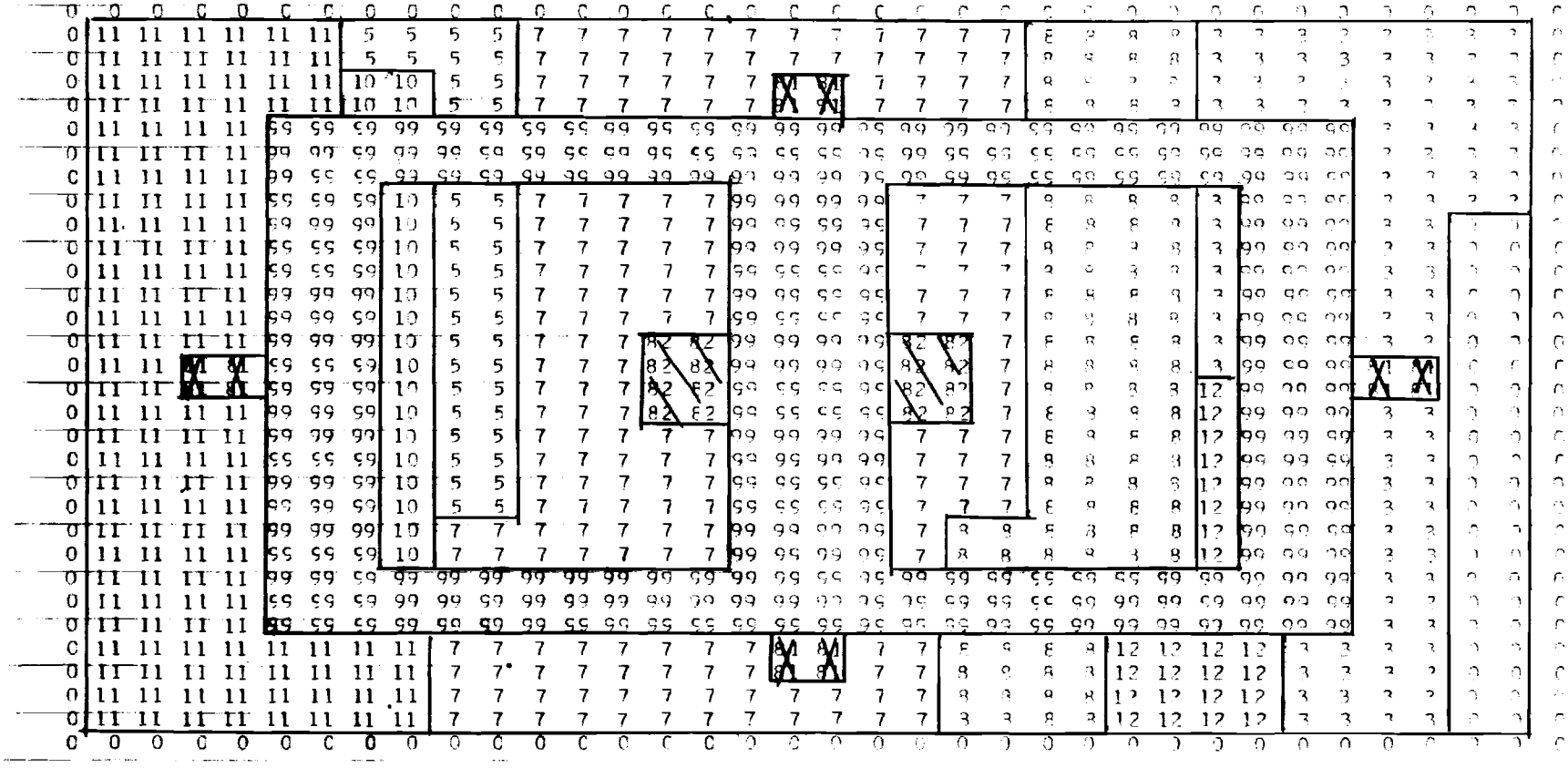
Sample out of 100 layouts



TOP FLOOR



GROUND FLOOR : TEST 2



TERRACE LEVEL : TEST 2

UNDER THE RULES FOR EVALUATION, THIS LAYOUT SATISFIES ALL NECESSARY RELATIONSHIPS

END OF THIS JOB
TOTAL DESIGNS 100
TOTAL ACCEPTED ... 64

CONDENSED

TENTATIVE SQUARE FOOTAGES FOR DEPARTMENTS

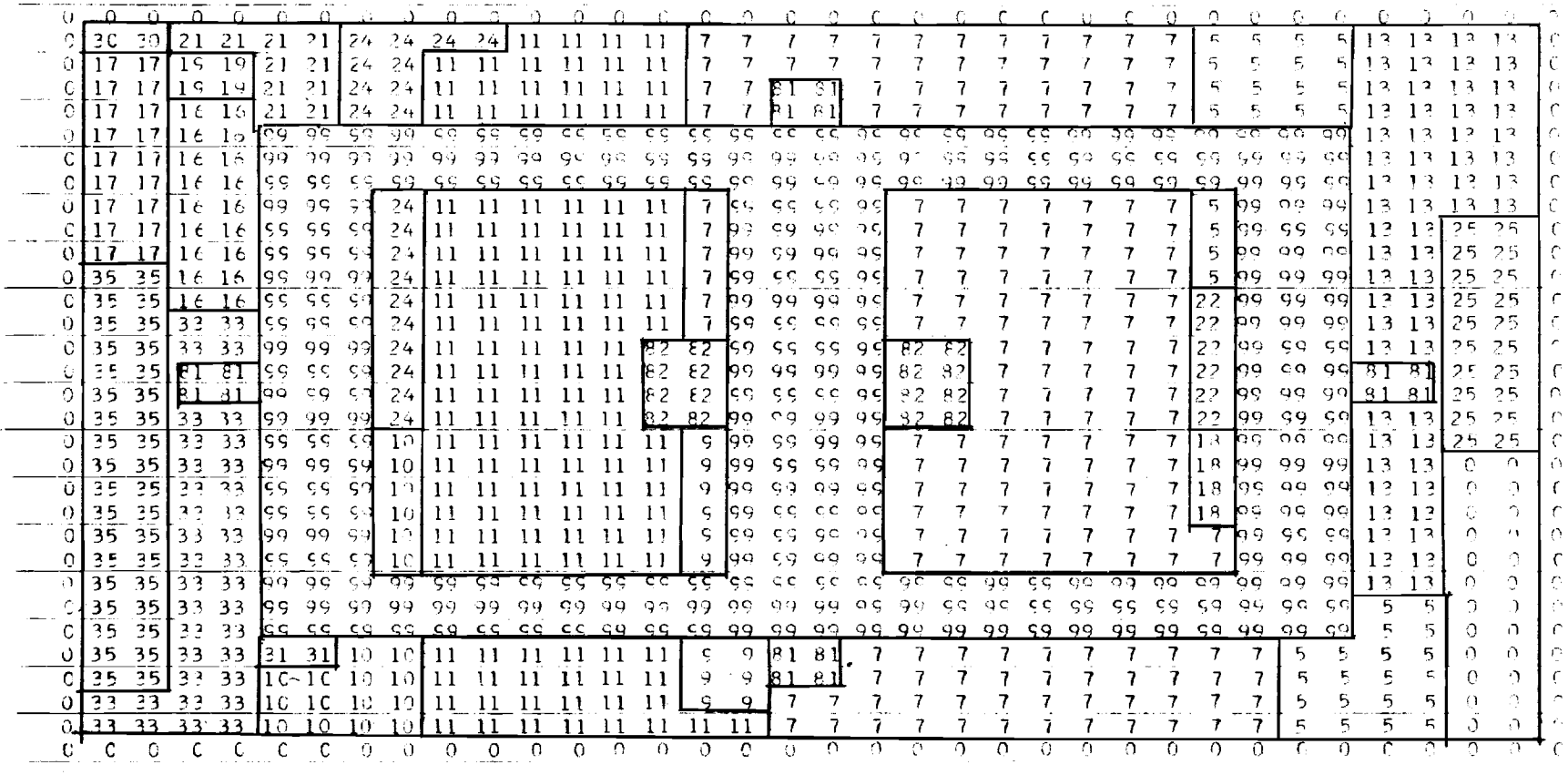
Test 3

Comp Code	Dept Code	Department	Sq Foot
1	110	Admin. office and Medical Records	3800
2	120	Admissions and Waiting Room	1750
3	130	Outpatient Department and Waiting Room	2600
4	140	Emergency Room and Waiting Room	2100
5	150	Radiology	1000
6	160	Operating Room, Recovery Room and Offices and Supplies	4000
7	170	Cafeteria (Hospital Personnel, Patients and Visitors)	5000
8	180	Central Supply	2500
9	190	Pharmacy	300
10	200	Pathology (Including Morgue and Autopsy)	500
11	210	Nursing Service and Doctor's Office	3500
12	220	Housekeeping, Maintenence and Waste Disposal	600
13	230	Purchasing and Storage	1500
14	240	On-Call Quarters (Doctors and Nurses)	1600
15	250	Blood Bank	1500
16	260	Nursing Station and Medicine Room Surgery	450
17	270	Nursing Station and Medicine Room Medicine	450

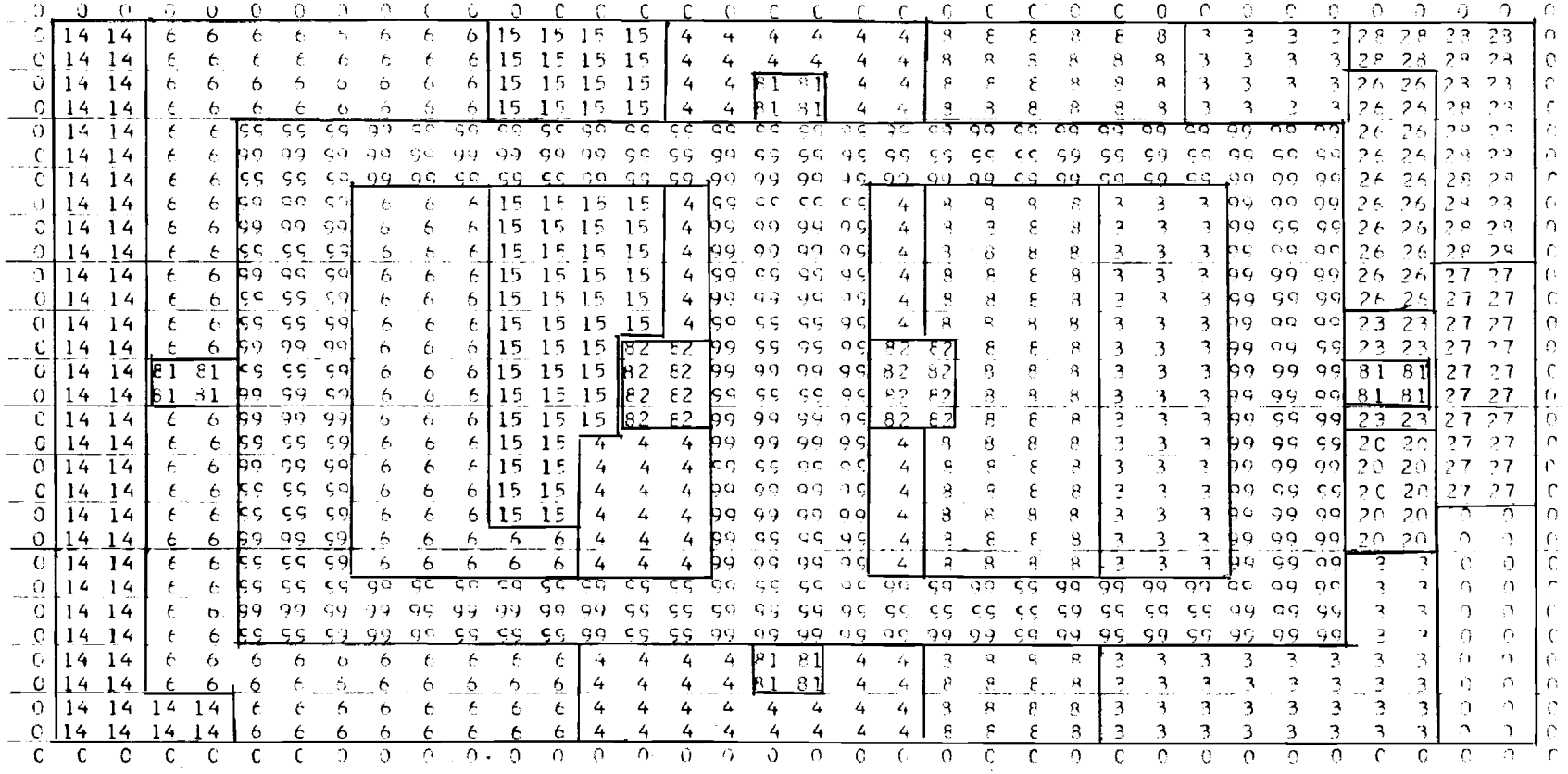
Comp Code	Dept Code	Department	Sq Foot
18	280	Linen Closet: Surgery	100
19	290	Linen Closet: Medicine	100
20	300	Shower: Surgery	250
21	310	Shower: Medicine	250
22	320	Kitchen Facility: Surgery	150
23	330	Kitchen Facility: Medicine	150
24	340	Nurse Conference and Rest Room: Surgery	500
25	350	Nurse Conference and Rest Room: Medicine	500
26	360	Doctor's Conference and Rest Room: Surgery	500
27	370	Doctor's Conference and Rest Room: Medicine	500
28	380	Visiting Room: Surgery	600
29	390	Visiting Room: Medicine	600
30	400	Dirty Linen Chute: Surgery	50
31	410	Dirty Linen Chute: Medicine	50
32	420	Surgical Patient (2 Man) Room	
		15 Rooms	4500
33	430	Surgical Intensive Care 4 Man	
		Single Rooms	900
34	440	Medical Patient (2 Man) Room	
		15 Rooms	4500
35	450	Medical Intensive Care 4 Man	
		Single Rooms	900

TEST 3

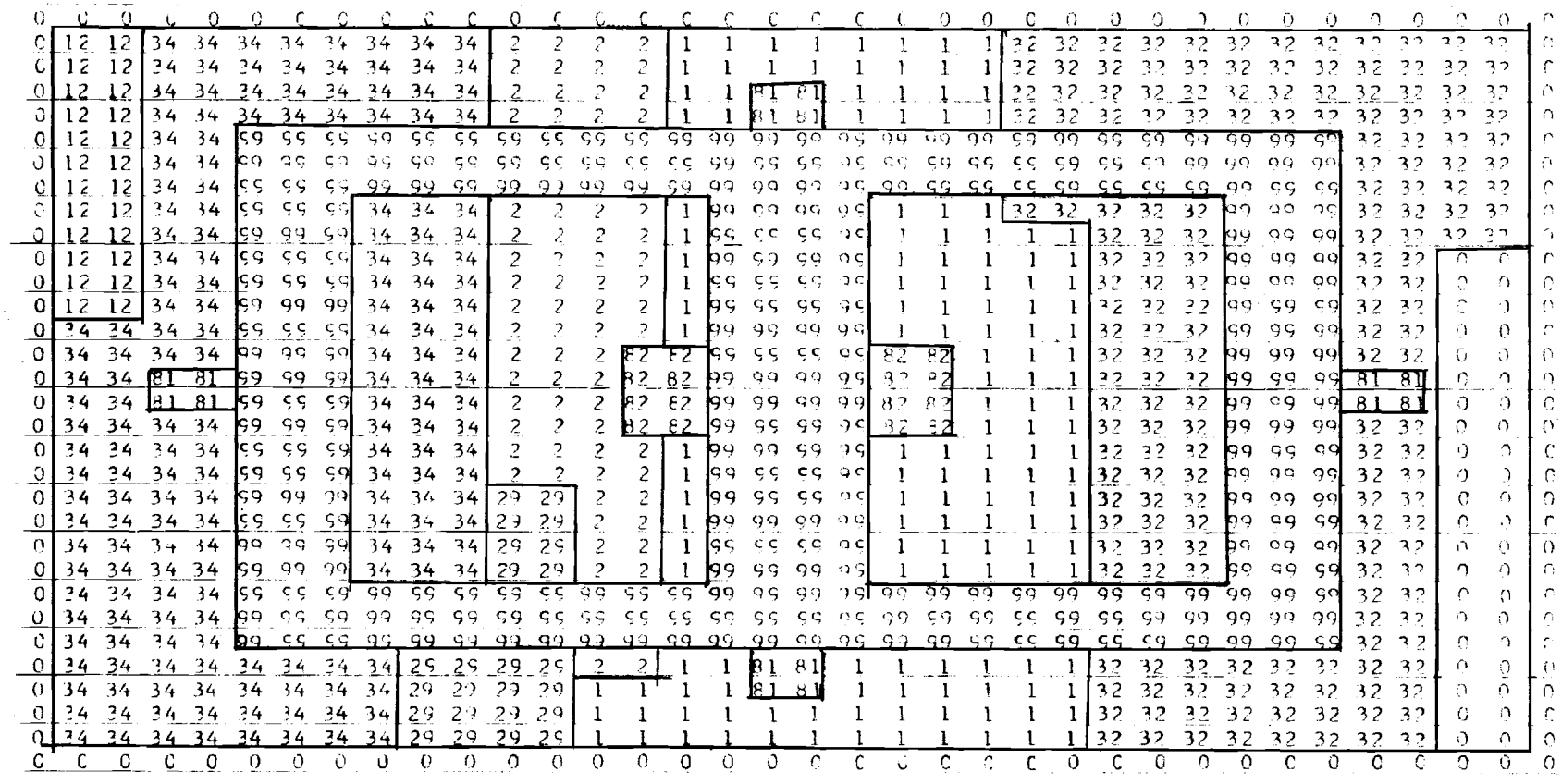
TRIAL LAYOUT 82A SCORE = 54A



TOP FLOOR



GROUND FLOOR: TEST 3



TERRACE LEVEL: TEST 3

UNDER THE RULES FOR EVALUATION, THIS LAYOUT SATISFIES ALL NECESSARY RELATIONSHIPS

CONCEPTUAL HOSP.

ACTIVITY RELATIONSHIP CHART

COMBINED PATIENT ROOMS WITH FLOOR ASSIGNMENT RESTRICTION REMOVED

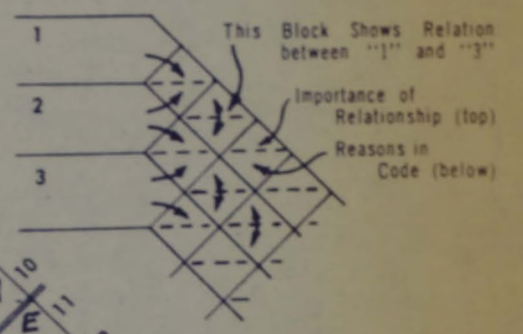
[redacted] Project

[redacted] TEST 3 With

Date 5/10/69 Sheet of

Reference

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	ADMINISTRATION & 110 MEDICAL RECORDS	E	O	O	O	O	O	O	O	O	U	U	U	U	U	U	U	U	U	U	U
2	ADMISSION & 120 WAITING ROOM	I	O	O	O	O	O	O	O	U	U	U	U	U	U	U	U	U	U	U	U
3	OUTPATIENT DEPT. 130 & WAITING ROOM	E	O	O	O	O	O	O	U	U	U	U	U	U	U	U	U	U	U	U	U
4	EMERGENCY ROOM 140 & WAITING ROOM	I	O	O	O	O	O	U	U	U	U	U	U	U	U	U	U	U	U	U	U
5	150 RADIOLOGY	E	X	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
6	OPERATING ROOM 160 & RECOVERY ROOM	U	I	I	O	O	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
7	170 CAFETERIA	O	I	U	I	X	O	U	U	U	U	U	U	U	U	U	U	U	U	U	U
8	180 CENTRAL SUPPLY	E	U	I	U	U	O	U	X	U	U	U	U	U	U	U	U	U	U	U	U
9	190 PHARMACY	I	U	U	O	O	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	200 PATHOLOGY	U	U	E	O	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	NURSING SERVICE 210 & DOCTOR'S OFFICE	U	I	O	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12	HOUSEKEEPING & 220 MAINTENENCE	O	U	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13	PURCHASING & 230 STORAGE	U	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	ON-CALL QTRS 240 NURSE & DOCTOR	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15	250 BLOOD BANK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16	NURSE STATION: 260 SURGERY DIV.	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
17	NURSE STATION 270 MEDICINE DIV.	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
18	LINEN CLOSET 280 SURGERY DIV	U	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
19	LINEN CLOSET 290 MEDICINE DIV	E	E	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
20	SHOWER 300 SURGERY DIV	U	U	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	SHOWER 310 MEDICINE DIV	I	I	I	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	KITCHEN 320 SURGERY DIV	U	U	U	U	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	KITCHEN 330 MEDICINE DIV	U	I	U	U	U	U	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	NURSE CONF & 340 REST ROOM: SURG	O	U	U	U	U	U	U	X	X	X	X	X	X	X	X	X	X	X	X	X
5	NURSE CONF & 350 REST ROOM: MED	O	O	U	U	U	U	U	U	X	X	X	X	X	X	X	X	X	X	X	X
6	DOCTORS CONF & 360 REST ROOM: SURG	O	U	U	U	X	X	U	U	U	X	X	X	X	X	X	X	X	X	X	X
7	DOCTORS CONF & 370 REST ROOM: MED	U	U	U	U	U	X	U	U	U	U	X	X	X	X	X	X	X	X	X	X
8	VISITING ROOM 380 SURGERY DIV	O	U	U	U	U	U	U	U	U	U	U	X	X	X	X	X	X	X	X	X
9	VISITING ROOM 390 MEDICINE DIV	U	U	U	U	U	U	U	U	U	U	U	U	X	X	X	X	X	X	X	X
10	DIRTY LINEN 400 SURGERY DIV	U	U	X	U	U	U	U	U	U	U	U	U	U	X	X	X	X	X	X	X
11	DIRTY LINEN 410 MEDICINE DIV	U	X	U	X	U	U	U	U	U	U	U	U	U	U	X	X	X	X	X	X
12	SURGICAL PATIENT 420 15-2 MAN ROOMS	O	U	X	U	X	U	U	U	U	U	U	U	U	U	U	X	X	X	X	X
13	SURGICAL INTENSIVE 430 CARE & SINGLE ROOM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	MEDICAL PATIENT 440 15-2 MAN ROOMS	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
15	MEDICAL INTENSIVE 450 CARE & SINGLE ROOM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
16																					
17																					
18																					
19																					
20																					



Value	CLOSENESS	VALUE SCORE
A	Absolutely Necessary	99
E	Especially Important	64
I	Important	4
O	Ordinary Closeness OK	1
U	Unimportant	0
X	Undesirable	−1

"Closeness" Rating

Code	REASON
1	
2	
3	
4	
5	
6	
7	
8	
9	

Reasons behind the "Closeness" Value

ACTIVITY RELATIONSHIP CHART

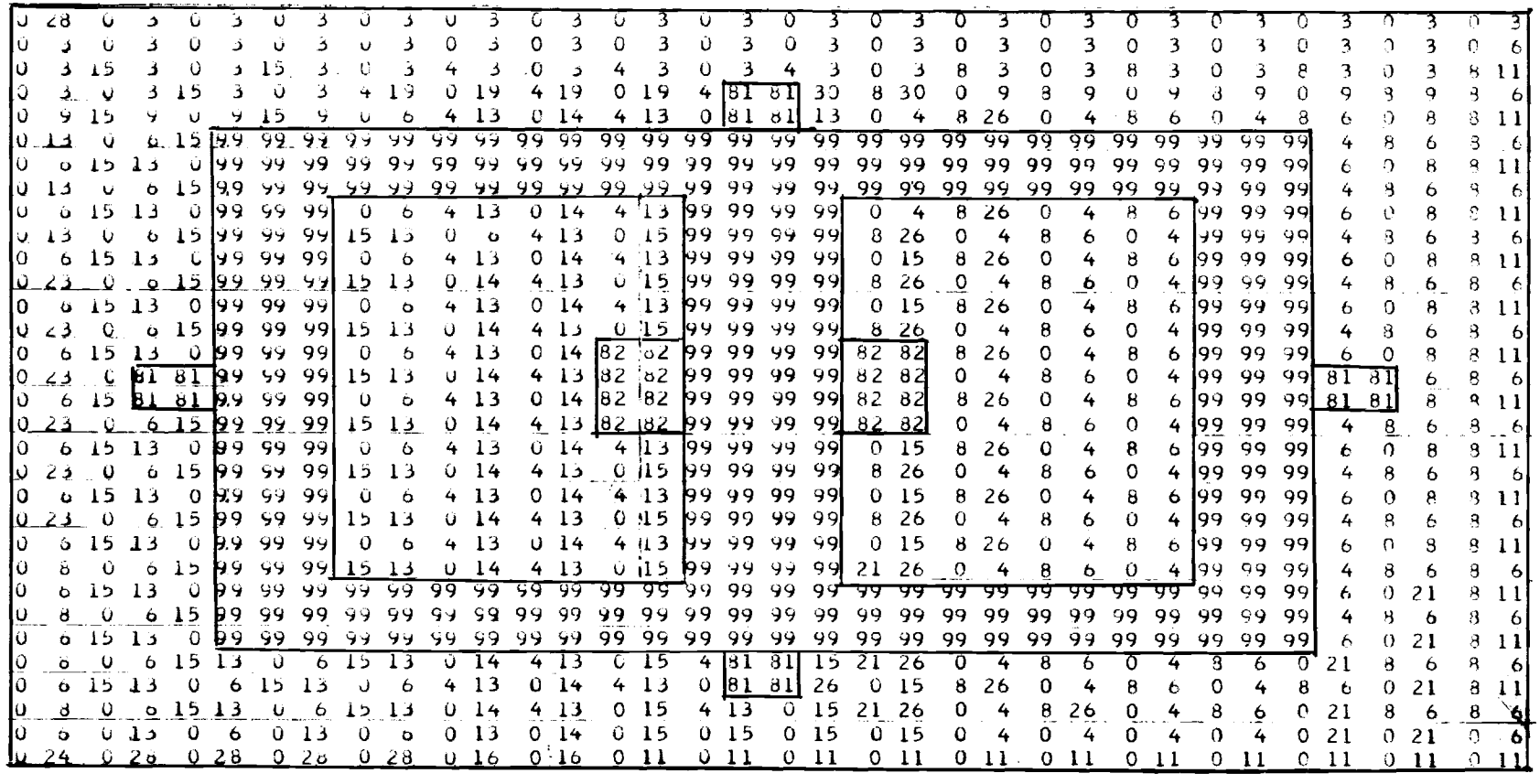
Test 3

The Activity Relationship Chart for test 3 is a condensed version of the activity relationship chart used in tests 1 and 2. All of the relationships are the same, the only difference being, the patient rooms are considered as a single department for each of the two services, surgical and medical, rather than as separate, individual departments.

TRIAL LAYOUT 2A SCORE = 393 TEST 3, CHANGE START POSITION

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	35	0	35	0	24	0	24	0	7	0	7	0	7	0	7	0	7
0	7	17	7	0	7	35	7	0	20	24	20	0	33	7	33	0	35	7	33	0	24	7	16	0	7	7	2	0	7	7	2	0	7	7	2
0	7	0	28	35	7	0	3	24	20	0	3	7	33	0	17	7	81	81	35	7	16	0	24	7	2	0	7	7	2	0	7	7	2	7	7
0	28	17	7	0	3	35	7	0	3	5	20	0	3	7	33	0	81	81	33	0	24	7	16	0	7	7	2	0	7	7	2	0	7	7	2
0	7	0	28	35	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	7	7	2	7	7
0	28	17	7	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	2	0	7	7	2
0	7	0	28	35	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	7	7	2	7	7
0	28	17	7	0	99	99	99	0	3	5	20	0	3	7	33	99	99	99	99	0	24	7	16	0	7	7	2	99	99	99	2	0	7	7	2
0	7	0	28	35	99	99	99	24	20	0	3	5	33	0	17	99	99	99	99	7	16	0	5	7	22	0	7	99	99	99	7	7	2	7	7
0	28	17	7	0	99	99	99	0	3	5	20	0	3	7	33	99	99	99	99	0	24	7	16	0	5	7	2	99	99	99	2	0	7	7	2
0	7	0	28	35	99	99	99	24	20	0	3	5	33	0	17	99	99	99	99	7	16	0	5	7	22	0	7	99	99	99	7	7	2	7	7
0	28	17	7	0	99	99	99	0	3	5	20	0	3	7	33	99	99	99	99	0	24	7	16	0	5	7	2	99	99	99	2	0	7	7	2
0	7	0	28	35	99	99	99	24	20	0	3	5	33	0	17	99	99	99	99	7	16	0	5	7	22	0	7	99	99	99	7	7	2	7	4
0	28	17	7	0	99	99	99	0	3	5	33	0	3	82	82	99	99	99	99	82	82	7	16	0	5	7	2	99	99	99	2	0	7	7	2
0	7	0	81	81	99	99	99	24	7	0	3	5	33	82	82	99	99	99	99	82	82	0	5	7	22	0	7	99	99	99	81	81	2	7	4
0	28	17	81	81	99	99	99	0	3	5	33	0	3	82	82	99	99	99	99	82	82	7	16	0	5	7	2	99	99	99	81	81	7	7	2
0	7	0	28	35	99	99	99	24	7	0	3	5	33	82	82	99	99	99	99	82	82	0	5	7	22	0	7	99	99	99	7	7	2	7	4
0	28	17	7	0	99	99	99	0	3	5	33	0	3	7	33	99	99	99	99	0	24	7	16	0	5	7	2	99	99	99	2	0	7	7	2
0	7	0	28	35	99	99	99	24	7	0	3	5	33	0	17	99	99	99	99	7	16	0	5	7	22	0	7	99	99	99	7	7	2	7	4
0	28	17	7	0	99	99	99	0	3	5	33	0	3	7	33	99	99	99	99	0	24	7	16	0	5	7	2	99	99	99	2	0	7	7	2
0	7	0	18	35	99	99	99	35	7	0	3	5	33	0	35	99	99	99	99	7	33	0	5	7	31	0	7	99	99	99	7	7	2	7	4
0	28	35	7	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	2	0	7	7	2
0	7	0	18	35	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	7	7	2	7	4
0	28	35	7	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	2	0	7	7	2
0	7	0	18	35	7	0	3	35	7	0	3	5	33	0	35	7	81	81	35	7	33	0	5	7	16	0	7	7	2	0	7	7	2	7	4
0	28	35	7	0	3	35	7	0	3	5	33	0	3	7	33	0	81	81	33	0	35	7	16	0	5	7	2	0	7	7	2	0	7	7	2
0	7	0	18	35	7	0	3	35	7	0	3	5	33	0	35	7	33	0	35	7	33	0	5	7	16	0	7	7	2	0	7	7	2	7	4
0	28	0	7	0	3	0	7	0	3	0	33	0	3	0	35	0	35	0	35	0	35	0	5	0	5	0	7	0	7	0	7	0	7	0	4
0	3	0	3	0	3	0	3	0	3	0	12	0	12	0	35	0	35	0	35	0	35	0	35	0	35	0	2	0	2	0	2	0	2	0	2

TOP FLOOR



GROUND FLOOR : TEST 3 ; CHANGE START POSITION

0	6	0	6	0	6	0	6	0	6	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14
0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	14	0	32
0	14	1	14	0	14	1	14	0	14	1	14	0	27	1	27	0	27	1	27	0	27	11	27	0	27	11	27	0	27	11	27	0	27	11	5
0	27	0	27	1	27	0	27	1	27	0	27	1	25	0	25	1	81	81	25	11	25	0	25	11	25	0	25	11	25	0	25	11	25	11	32
0	25	1	25	0	25	1	25	0	25	1	25	0	25	1	29	0	81	81	29	0	29	11	29	0	29	11	29	0	29	11	29	0	29	11	5
0	29	0	29	1	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	29	11	29	11	32
0	29	1	29	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	29	0	29	11	5
0	11	0	34	1	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	34	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	11	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	34	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	11	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	34	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	11	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	82	82	99	99	99	99	82	82	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	81	81	99	99	99	1	11	0	32	1	34	82	82	99	99	99	99	82	82	0	1	11	34	0	1	99	99	99	81	81	34	11	32
0	34	1	81	81	99	99	99	0	32	1	11	0	32	82	82	99	99	99	99	82	82	11	34	0	1	11	34	99	99	99	81	81	11	11	5
0	11	0	32	1	99	99	99	1	11	0	32	1	34	82	82	99	99	99	99	82	82	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	32	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	11	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	11	11	5
0	11	0	32	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	1	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	0	32	1	11	0	32	1	34	99	99	99	99	0	1	11	34	0	1	11	34	99	99	99	34	0	1	11	5
0	11	0	32	1	99	99	99	1	11	0	32	1	34	0	1	99	99	99	99	1	34	0	1	11	34	0	1	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	34	0	1	11	5
0	11	0	32	1	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	1	11	34	11	32
0	34	1	11	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	34	0	1	11	5
0	11	0	32	1	11	0	32	1	11	0	32	1	34	0	1	1	81	81	1	1	34	0	1	11	34	0	1	11	34	0	1	11	34	11	32
0	34	1	11	0	32	1	11	0	32	1	11	0	32	1	34	0	81	81	34	0	1	11	34	0	1	11	34	0	1	11	34	0	1	11	5
0	11	0	32	1	11	0	32	1	11	0	32	1	11	0	1	1	34	0	1	1	34	0	1	11	34	0	1	11	34	0	1	11	34	11	32
0	34	0	11	0	32	0	11	0	32	0	11	0	32	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	32
0	33	0	33	0	33	0	21	0	21	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	20	0	20	0	5

TERRACE LEVEL : TEST 3; CHANGE START POSITION

UNDER THE RULES FOR EVALUATION, THIS LAYOUT DOES NOT SATISFY THE FOLLOWING NECESSARY CLOSE RELATIONSHIPS

260	430
270	450
430	260
450	270

Conceptual Hosp.

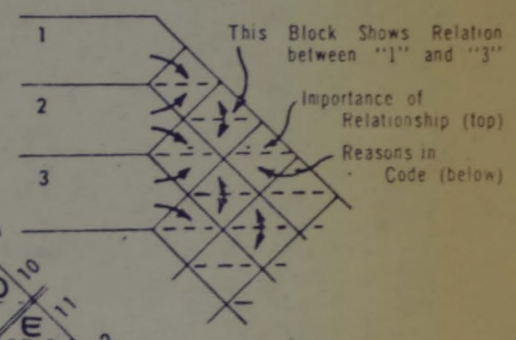
ACTIVITY RELATIONSHIP CHART

Plant _____ Project TEST 4

Charted by _____ With _____

Date _____ Sheet _____ of _____

Reference _____



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	110 Administration & Medical Records		E	O	I	O	O	I	O	A	E	U	U	U	U	U	U	U	U	U	U
2	120 Admission & Waiting Room			X	O	O	O	O	O	O	U	I	I	E	O	U	U	U	U	U	U
3	130 Outpatient Dept. & Waiting Room				X	O	X	O	O	U	U	U	E	U	U	U	U	U	U	U	U
4	140 Emergency Room & Waiting Room					O	O	O	U	O	U	U	U	U	U	U	U	U	U	U	U
5	150 Radiology						O	U	U	O	U	U	U	U	U	U	U	U	U	U	U
6	160 Operating Room & Recovery Room							U	U	U	U	U	U	U	U	U	U	U	U	U	U
7	170 Cafeteria								U	U	U	U	U	U	U	U	U	U	U	U	U
8	180 Central Supply									U	U	U	U	U	U	U	U	U	U	U	U
9	190 Pharmacy										U	U	U	U	U	U	U	U	U	U	U
10	200 Pathology											U	U	U	U	U	U	U	U	U	U
11	210 Nursing Service & Doctor's Office												U	U	U	U	U	U	U	U	U
12	220 Housekeeping & Maintenence													U	U	U	U	U	U	U	U
13	230 Purchasing & Storage														U	U	U	U	U	U	U
14	240 On-call Qtrs. Nurse & Doctor															U	U	U	U	U	U
15	250 Blood Bank																U	U	U	U	U
16	260 Nurse Station Surgery Div																	U	U	U	U
17	270 Nurse Station Medicine Div																		U	U	U
18	280 Linen Closet Surgery Div																			U	U
19	290 Linen Closet Medicine Div																				U
20	300 Shower Surgery Div																				
1	310 Shower Medicine Div																				
2	320 Kitchen Surgery Div																				
3	330 Kitchen Medicine Div																				
4	340 Nurse Conf & Rest Room Surg																				
5	350 Nurse Conf & Rest Room Med																				
6	360 Doctors Conf & Rest Room Surg																				
7	370 Doctors Conf & Rest Room Med																				
8	380 Visiting Room Surgery Div																				
9	390 Visiting Room Medicine Div																				
10	400 Dirty Linen Surgery Div																				
11	410 Dirty Linen Medicine Div																				
12	420 Surgical Patient 15-2 Man Rooms																				
13	430 Surgical Patient Intensive Care & Single Rooms																				
14	440 Medical Patient 15-2 Man Rooms																				
15	450 Medical Intensive Care & Single Room																				
16																					
17																					
18																					
19																					
20																					

Value	CLOSENESS	VALUE SCORE
A	Absolutely Necessary	99
E	Especially Important	64
I	Important	4
O	Ordinary Closeness OK	1
U	Unimportant	0
X	Undersirable	-1

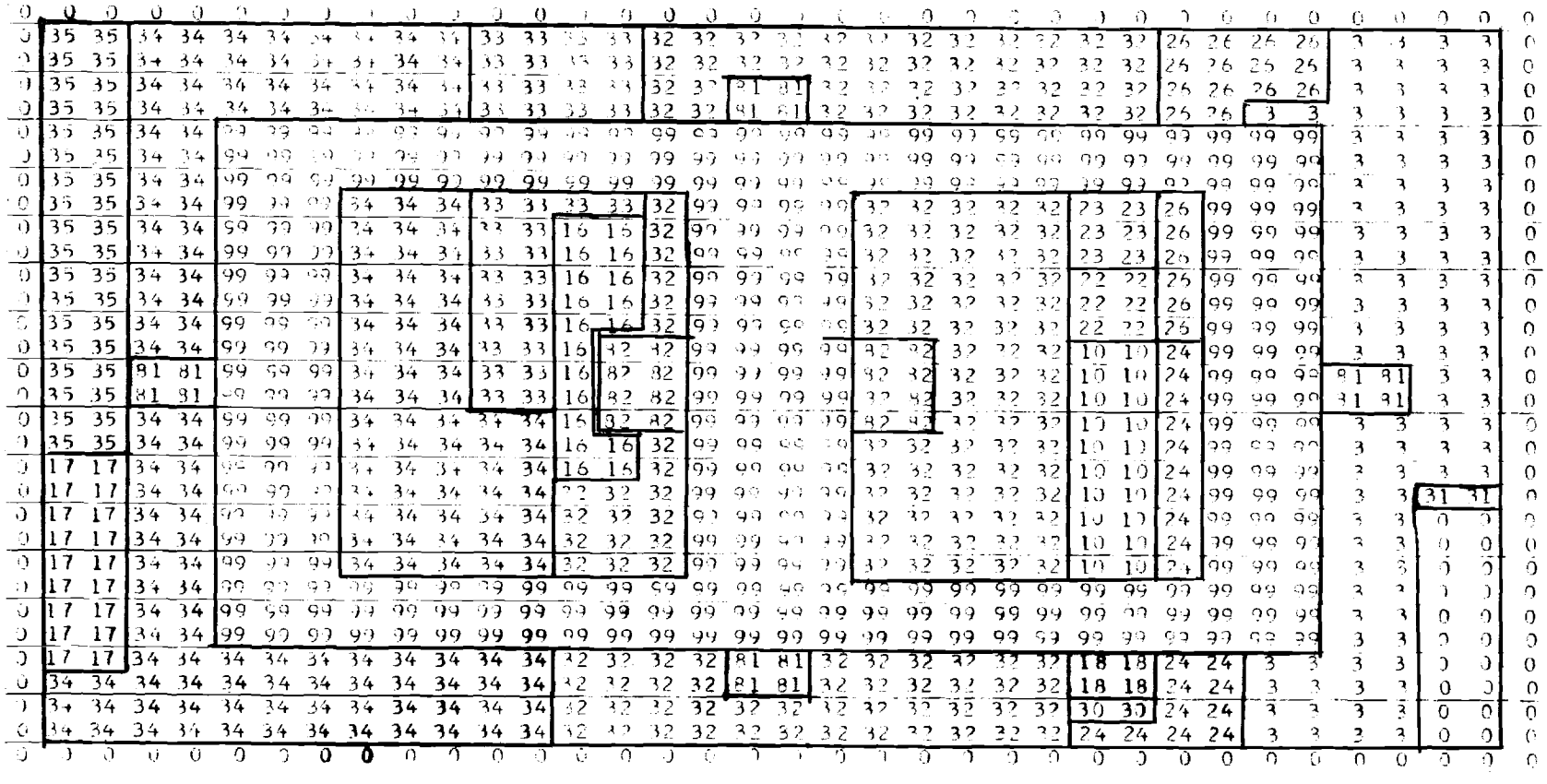
"Closeness" Rating

Code	REASON
1	
2	
3	
4	
5	
6	
7	
8	
9	

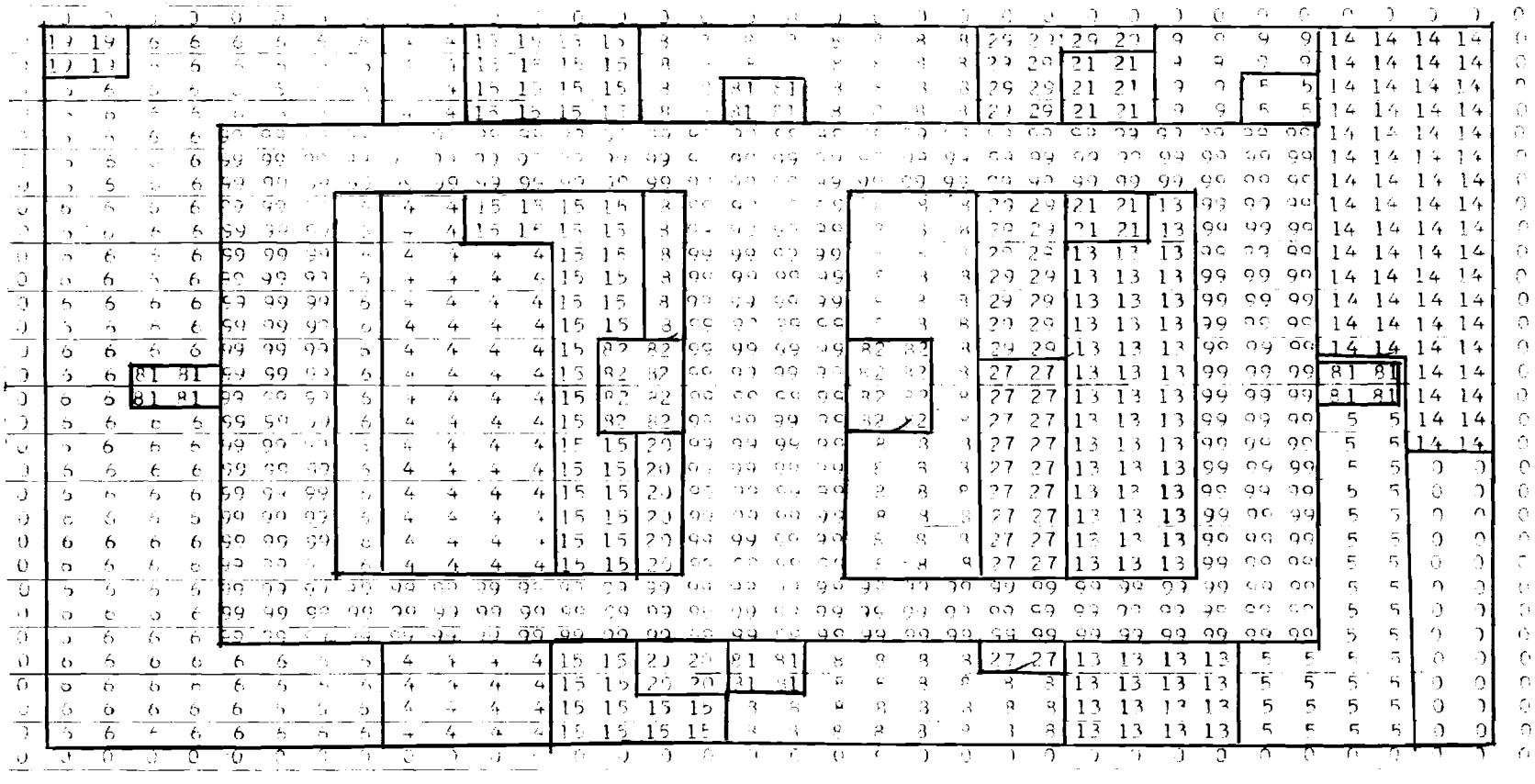
Reasons behind the "Closeness" Value

TOTAL LAYOUT 32A SCALE = 1/24

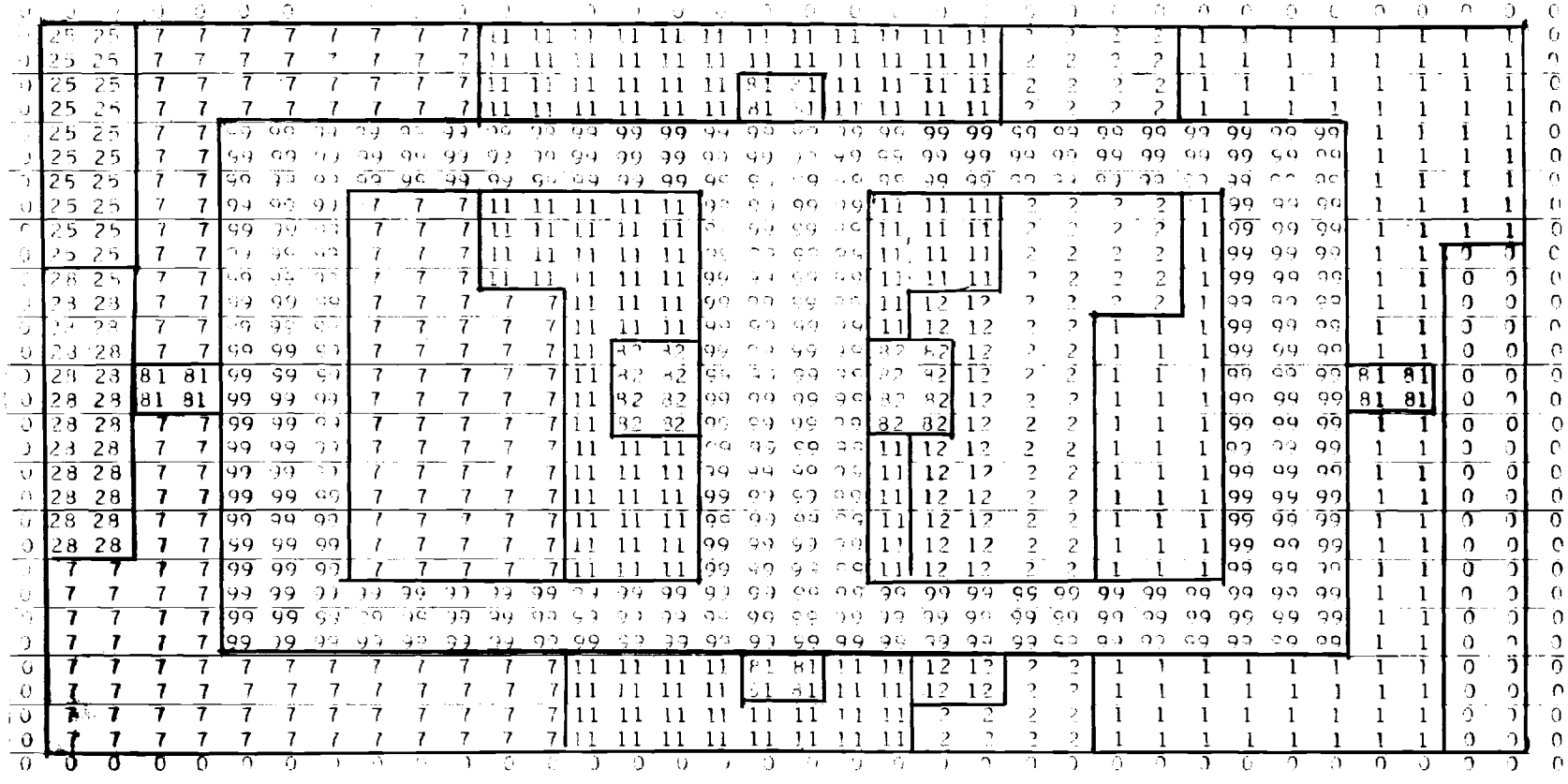
Test 4



TOP FLOOR



GROUND FLOOR : TEST 4



TERRACE LEVEL: TEST 4

UNDER THE RULES FOR EVALUATION, THIS LAYOUT DOES NOT SATISFY THE FOLLOWING NECESSARY CLOSE RELATIONSHIPS

160	240
160	250
240	16
250	16

SQUARE FOOTAGES FOR DEPARTMENTS

ATLANTA EYE CLINIC

Comp Code	Dept Code	Department	Sq Foot
1	110	Administrator	200
2	120	Refraction	450
3	130	Minor Surgery	525
4	140	Clinic	5300
5	150	Waiting Room - Clinic	1075
6	160	P.B.X.	100
7	170	Business Office and Admissions	1050
8	180	Day Room - Patients	400
9	190	Medical Records	525
10	200	Patient Rooms - Group I	7775
11	210	Rest Rooms - Group I	150
12	220	Drup Preparation and Storage - Group I	125
13	230	Examination Room - Group I	100
14	240	Nurse Station - Group I	150
15	250	Nurse Lounge - Group I	150
16	260	Soiled Linen - Group I	125
17	270	Sterile Linen - Group I	100
18	280	Food Preparation - Group I	150
19	290	Janitor - Group I	75
20	300	Storage - Group I	75
21	310	Operating Suite	3150

Comp Code	Dept Code	Department	Sq Foot
22	320	Patient Room - Group II	7290
23	330	Waiting Room - Operating Room	475
24	340	Rest Room - Group II	150
25	350	Drug Preparation and Storage - Group II	125
26	360	Examination Room - Group II	100
27	370	Nurse Station - Group II	150
28	380	Nurse Lounge - Group II	150
29	390	Soiled Linen - Group II	125
30	400	Sterile Linen - Group II	100
31	410	Food Preparation - Group II	150
32	420	Janitor - Group II	75
33	430	Anesthesia and Oxygen Storage	75
34	440	X-Ray	1925
35	450	Pharmacy	150
36	460	Elevator - Second Floor	50
37	470	Elevator - Third Floor	50

DESIRED DEPARTMENTAL RELATIONSHIPS

ATLANTA EYE CLINIC

1 - Administrator's Office away from the main flow of traffic between the admissions and business office.

2 - X-Ray department near the clinic and the operating suite.

3 - The refraction department absolutely close to the clinic.

4 - Minor surgery absolutely close to the clinic: more of an emergency department.

5 - Waiting room for the clinic absolutely close to the clinic.

6 - The P.B.X. and the clinic especially close to one another.

7 - Medical Records especially close to the business office.

8 - Nurse's station adjacent to the nurse's lounge.

9 - Soiled linen chute away from the nurse's station.

10 - Sterile linen relatively close to the nurse's station.

11 - The waiting room for the operating room away from the operating suite but near the nurse's station.

12 - Pharmacy relatively close to the waiting room for the clinic.

13 - P.B.X. must be located on the first floor and in the input position.

14 - It is unimportant for the minor surgery to be close to the operating suite.

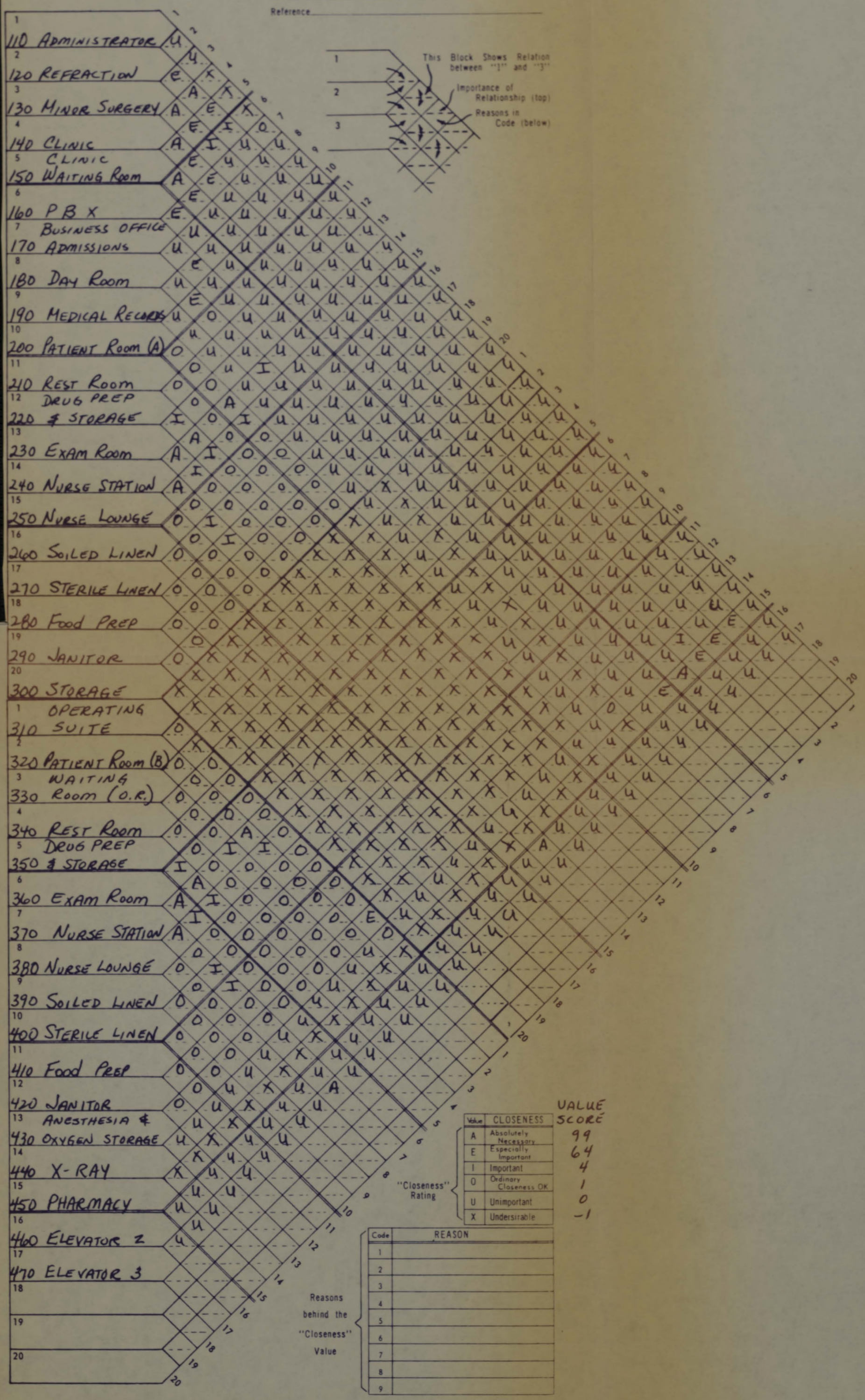
ATLANTA EYE CLINIC AND HOSPITAL
ACTIVITY RELATIONSHIP CHART

Plant _____ Project _____

Charted by _____ With _____

Date _____ Sheet _____ of _____

Reference _____



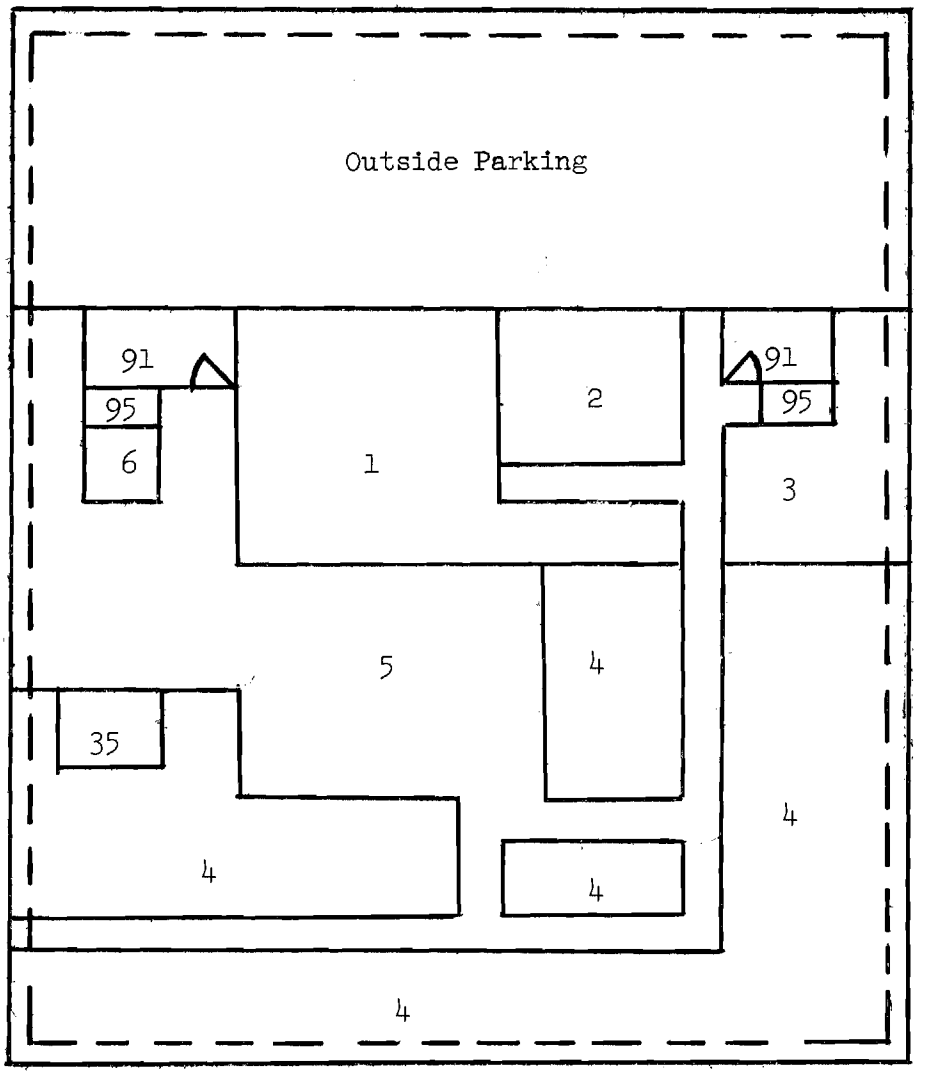
Value	CLOSENESS	VALUE SCORE
A	Absolutely Necessary	99
E	Especially Important	64
I	Important	4
O	Ordinary Closeness OK	1
U	Unimportant	0
X	Undesirable	-1

"Closeness" Rating

Code	REASON
1	
2	
3	
4	
5	
6	
7	
8	
9	

Reasons behind the "Closeness" Value

ATLANTA EYE CLINIC



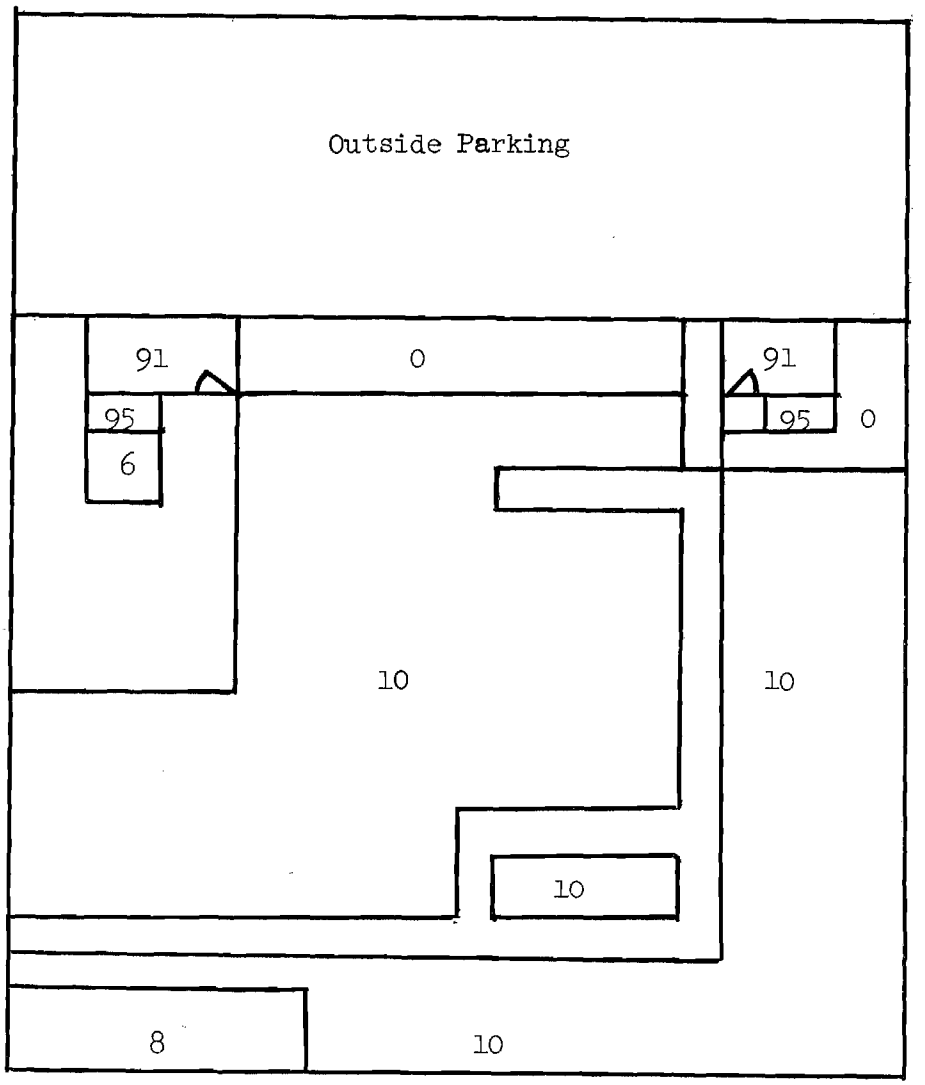
First Floor

Square Footage Requirements:

Floor Space	8,850
Corridors	2,375
Elevators	100
Stairs	350
Buffer	325
Total	12,000

Refer to appendix page 69 for department code

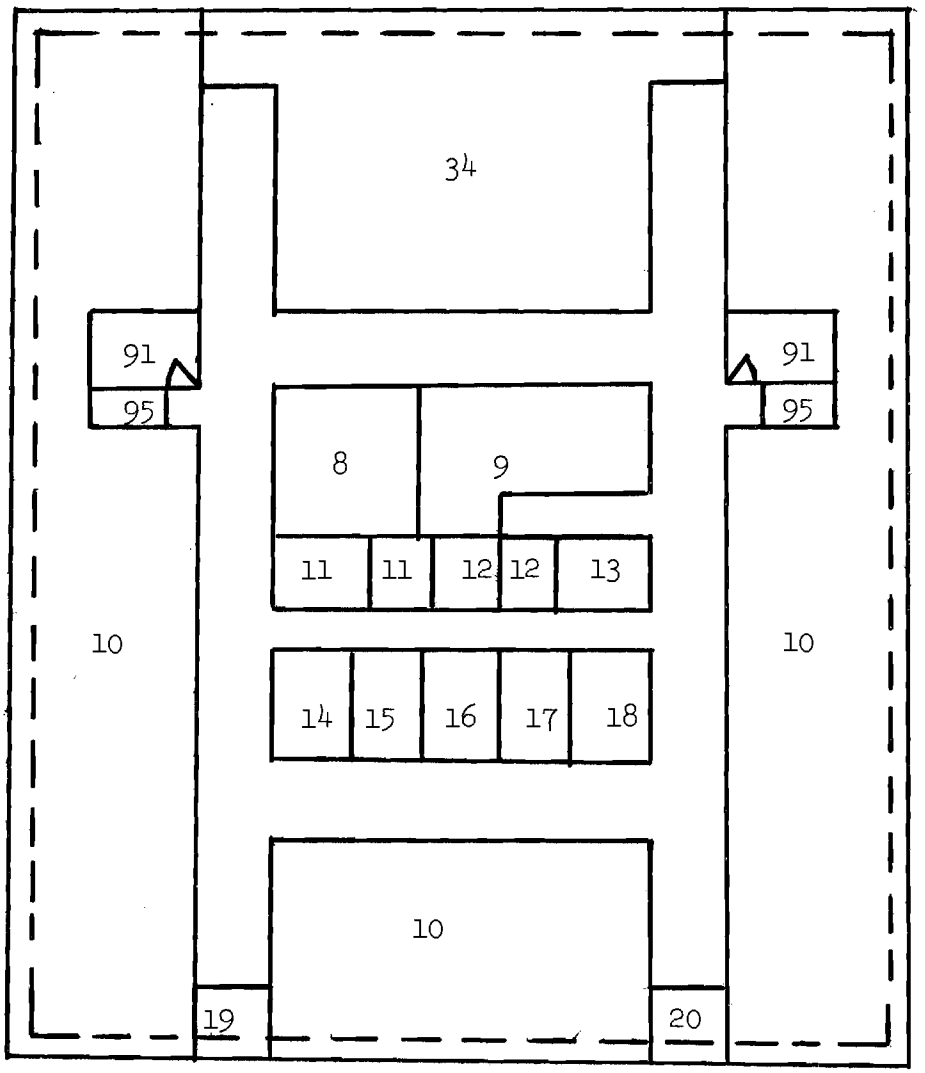
ATLANTA EYE CLINIC - ALDEP LAYOUT



First Floor

Refer to appendix page 69 for department code

ATLANTA EYE CLINIC



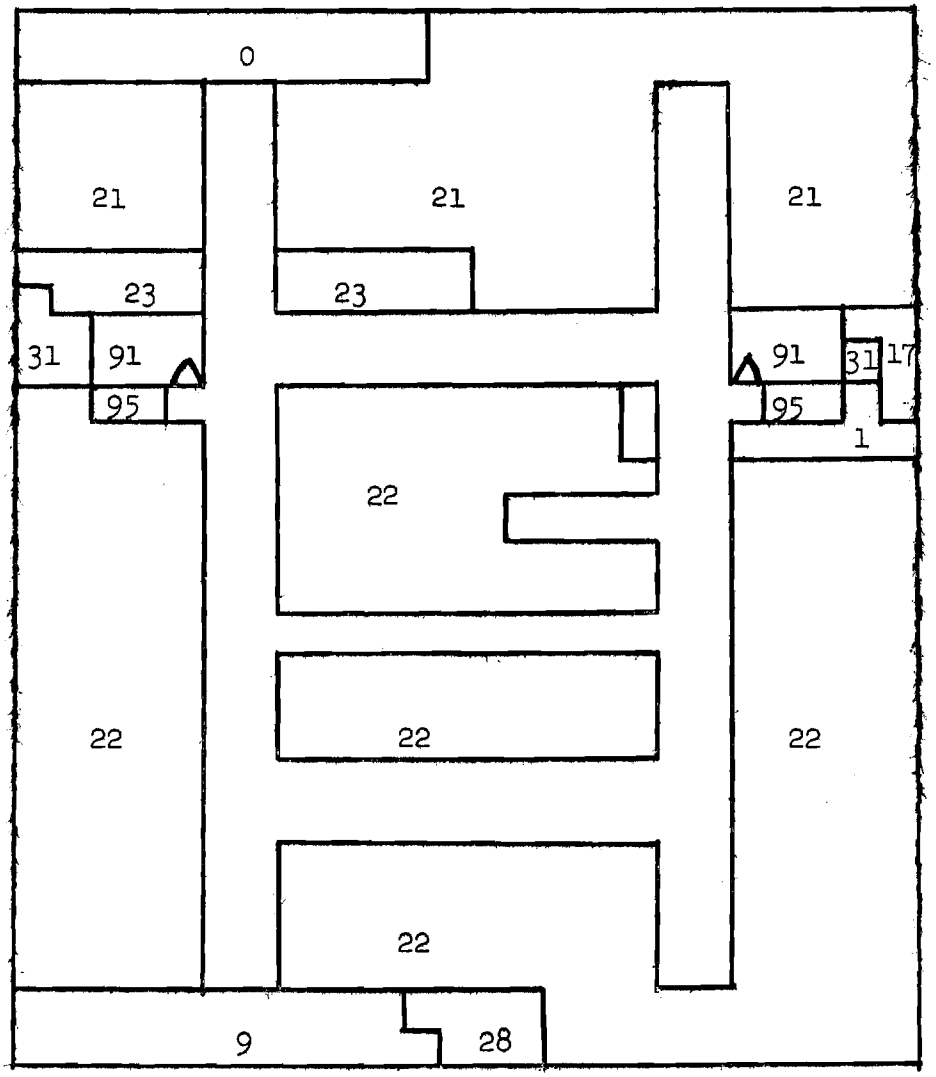
Second Floor

Square Footage Requirements:

Floor Space	11,825
Corridors	3,800
Elevators	100
Stairs	300
Buffer	775
Total	16,800

Refer to appendix page 69 for department code

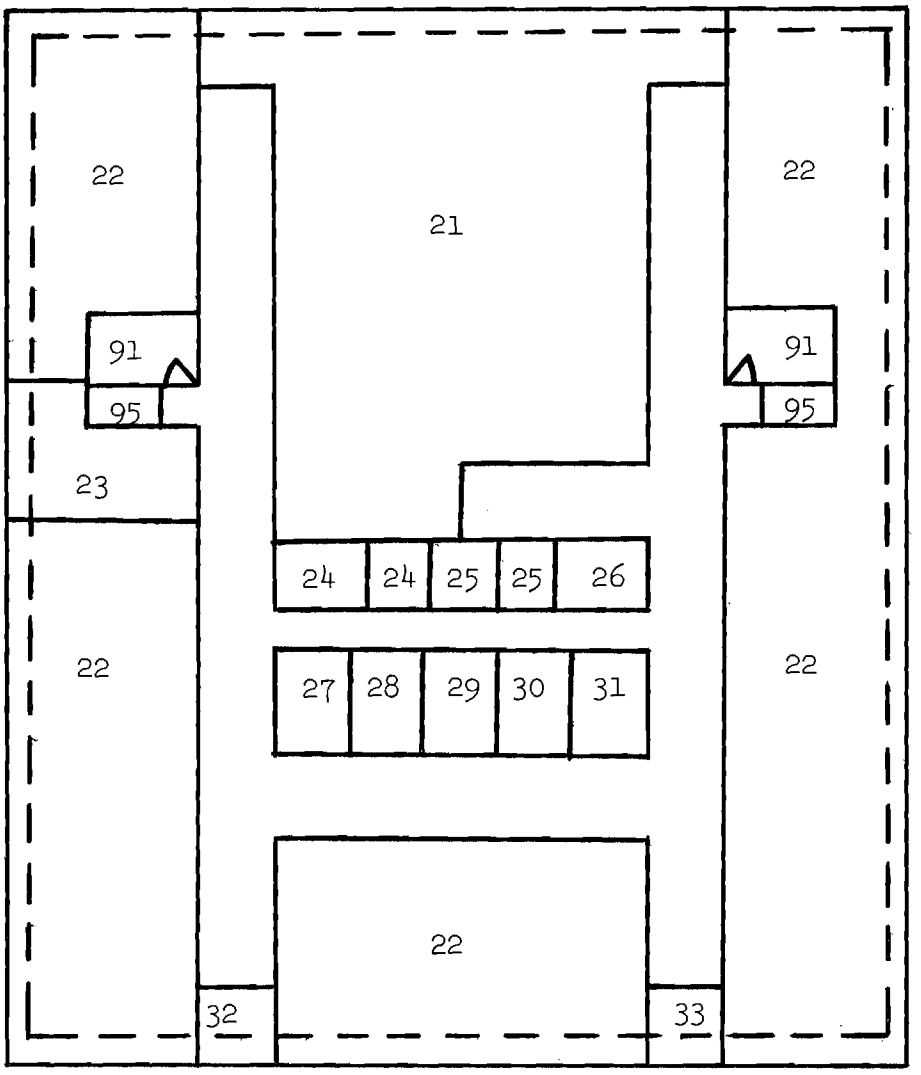
ATLANTA EYE CLINIC - ALDEP LAYOUT



Second Floor

Refer to appendix page 69 for department code

ATLANTA EYE CLINIC



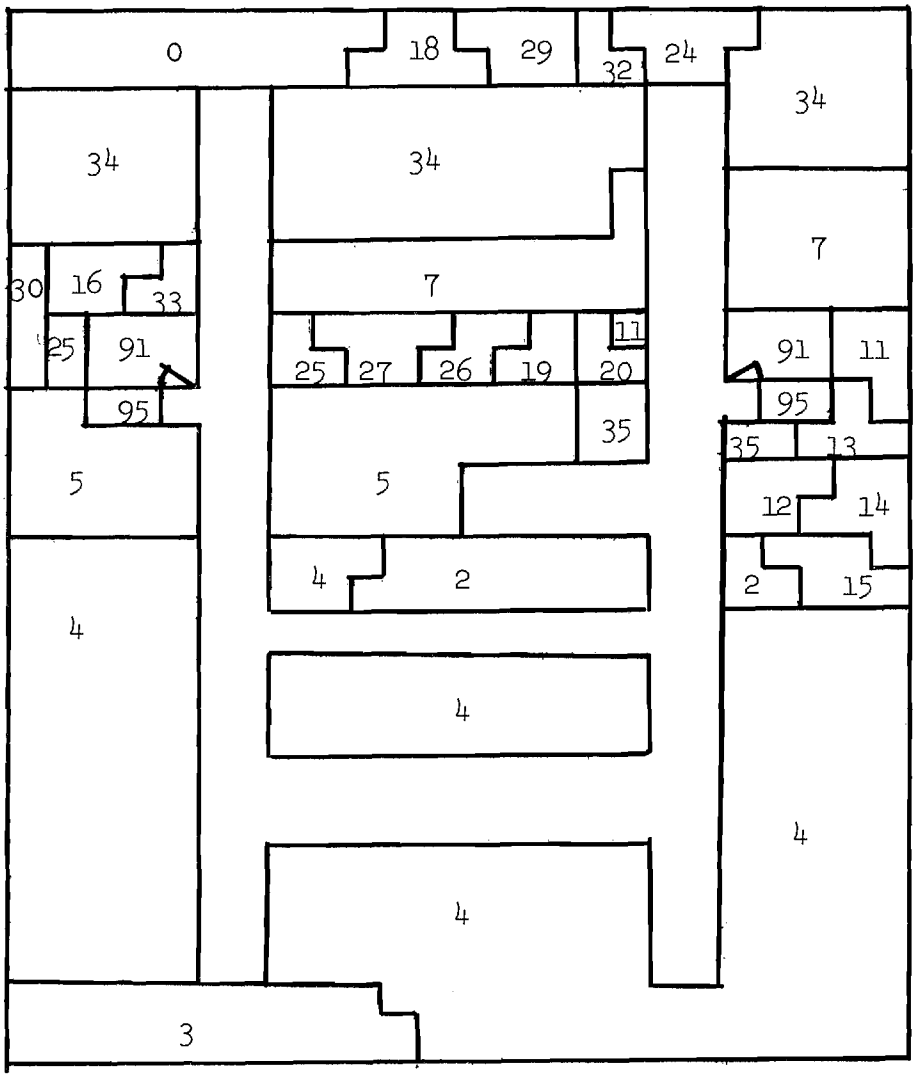
THIRD FLOOR

Square Footage Requirements:

Floor Space	12,425
Corridors	3,450
Elevators	100
Stairs	300
Buffer	525
Total	16,800

Refer to appendix page 69 for department code

ATLANTA EYE CLINIC - ALDEP LAYOUT

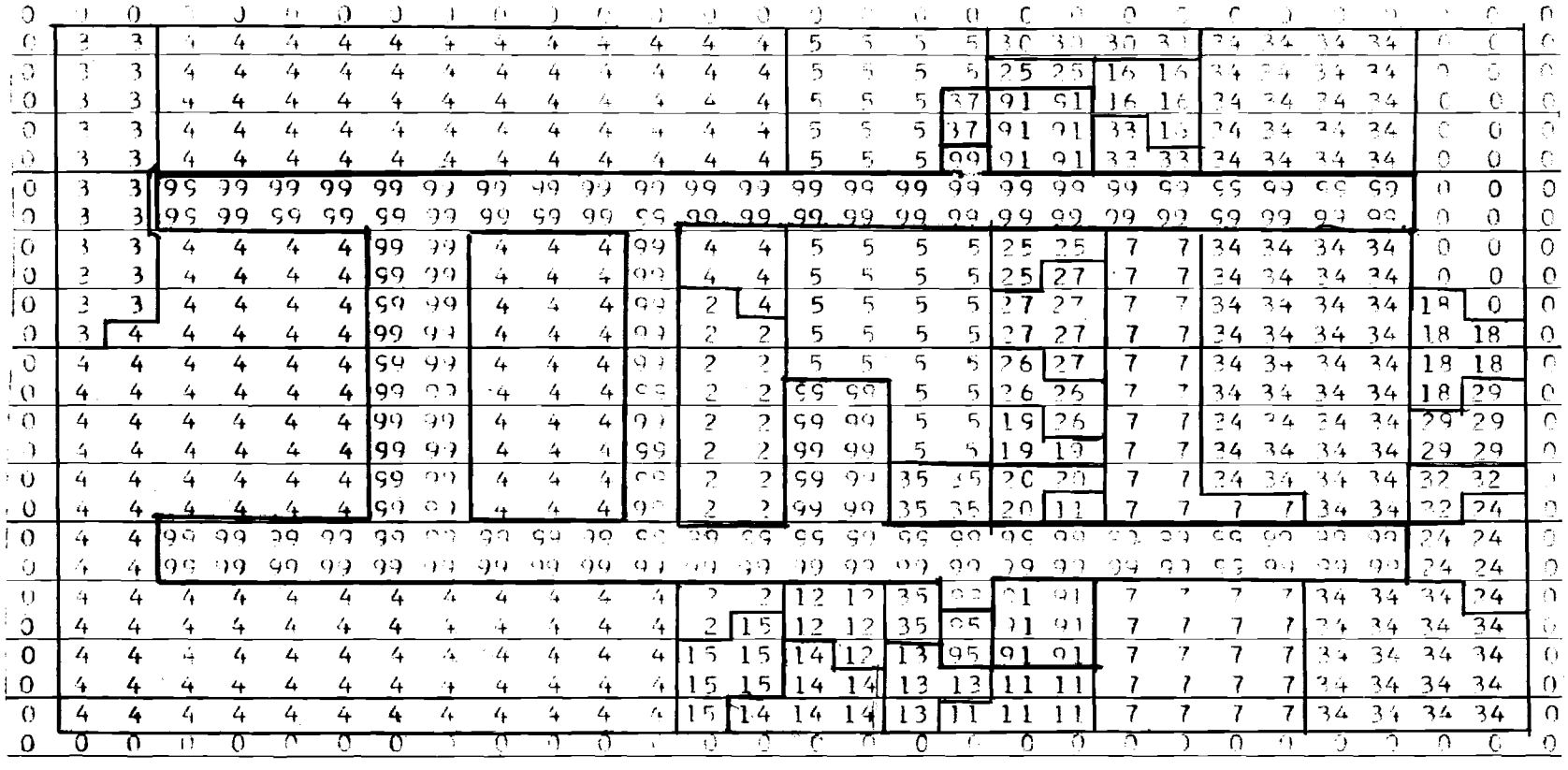


Third Floor

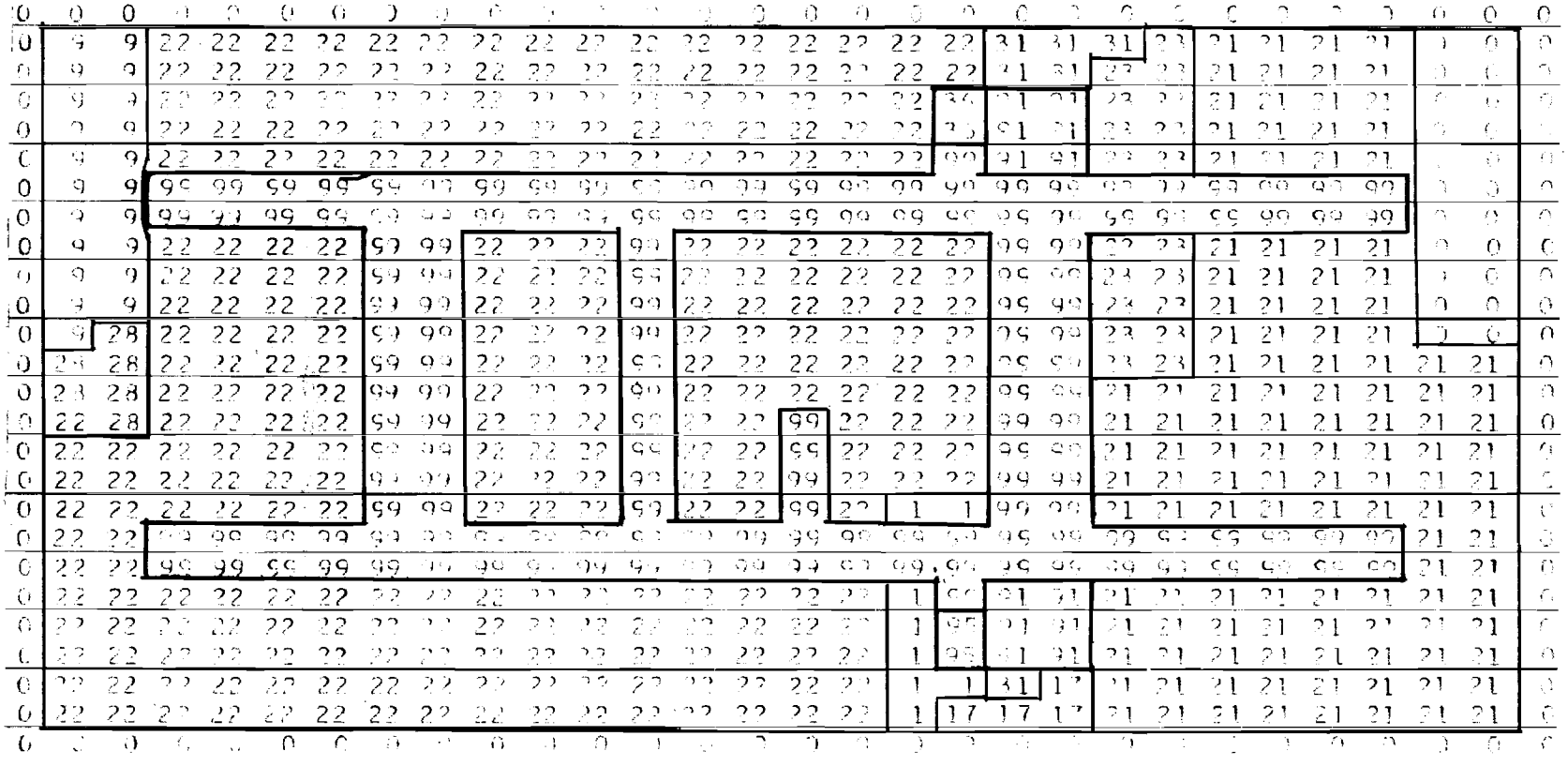
Refer to appendix page 69 for department code

TRIAL LAYOUT 50P SCOPE = 9071

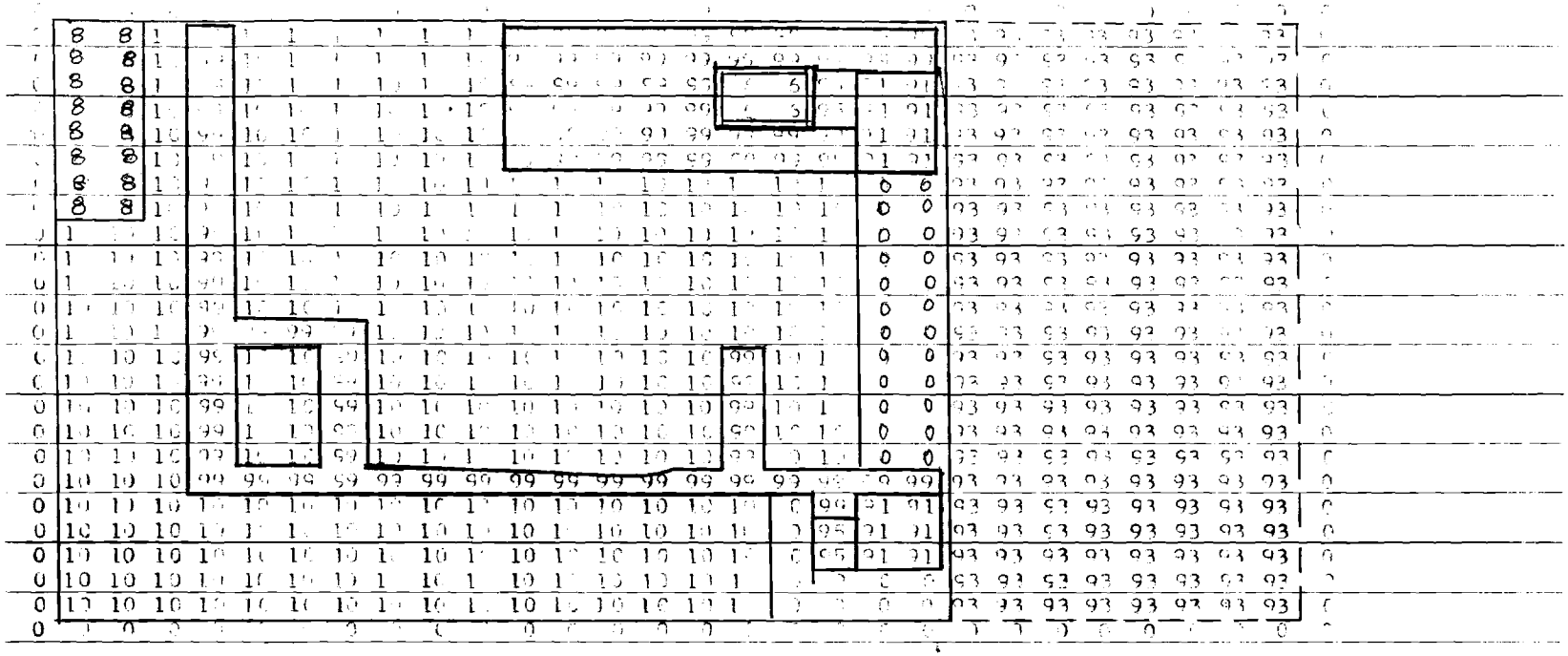
ATLANTA EYE CLINIC & HOSPITAL



TOP FLOOR



GROUND FLOOR : ATLANTA EYE CLINIC & HOSPITAL



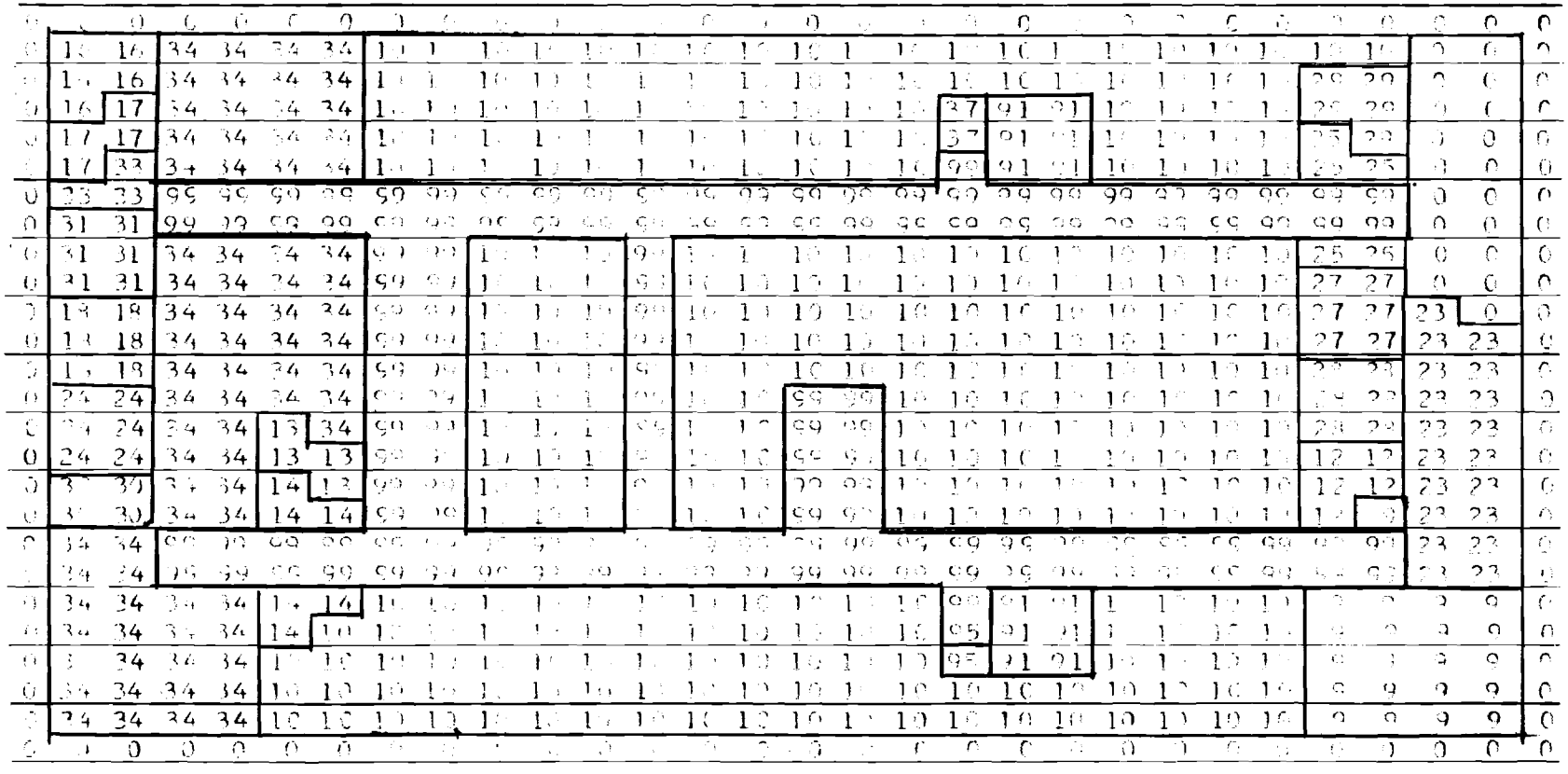
TERRACE LEVEL 1 ATLANTA EYE CLINIC & HOSPITAL

UNDER THE RULES FOR EVALUATION, THIS LAYOUT DOES NOT SATISFY THE FOLLOWING NECESSARY CLOSE RELATIONSHIPS

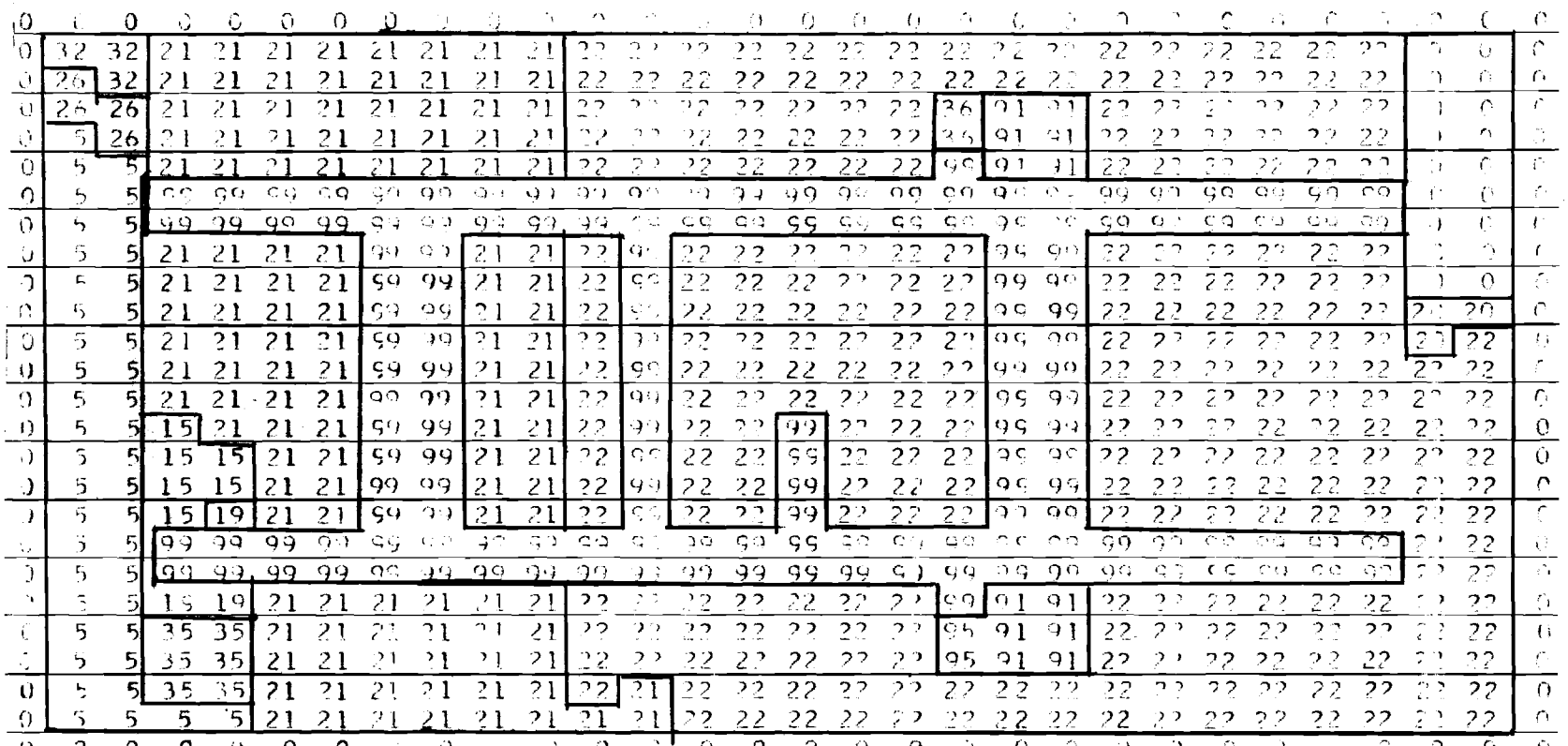
150	160	WAITING ROOM - PBX
160	150	
200	240	PATIENT ROOM - NURSE STATION
240	200	
240	460	NURSE STATION - ELEVATOR
320	370	PATIENT ROOM - NURSE STATION
370	320	
370	330	NURSE STATION - NURSE LOUNGE
370	470	NURSE STATION - ELEVATOR
330	370	
460	240	
470	370	

TOTAL LAYOUT 1338 SCALE = 577

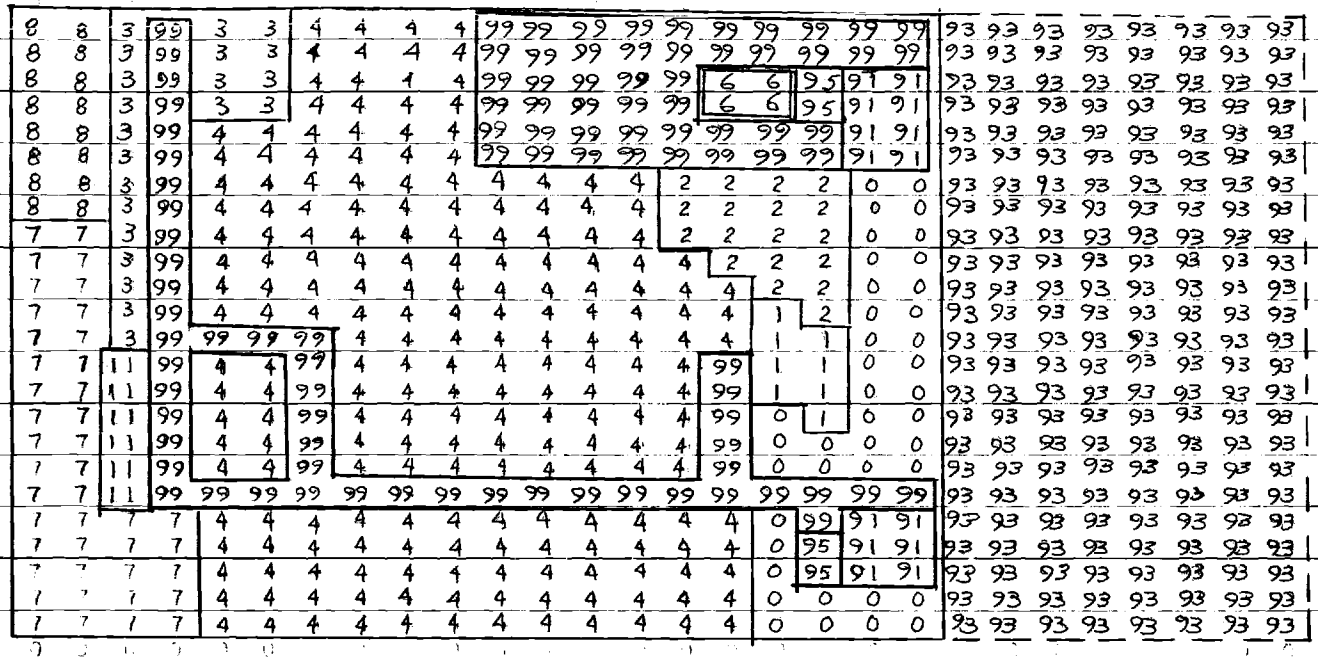
ATLANTA EYE CLINIC & HOSPITAL



TOP FLOOR



GROUND FLOOR : ATLANTA EYE CLINIC & HOSPITAL



TERRACE LEVEL : ATLANTA EYE CLINIC & HOSPITAL

UNDER THE RULES FOR EVALUATION, THIS LAYOUT DOES NOT SATISFY THE FOLLOWING NECESSARY CLOSE RELATIONSHIPS

140	150	CLINIC - WAITING ROOM	?
150	140		
150	160	WAITING ROOM - POX	?
160	150		
220	240	DRUG PREP - NURSE STATION	?
240	220		
240	250	NURSE STATION - NURSE LOUNGE	?
240	460	NURSE STATION - ELEVATOR	?
250	240		
320	370	PATIENT ROOM - NURSE STATION	X
360	370	EXAM ROOM - NURSE STATION	?
370	320		
370	360		
370	470	NURSE STATION - ELEVATOR	?
460	240		
470	370		

BIBLIOGRAPHY

LITERATURE CITED

1. Marion B. Folsom, "Haphazard Planning Blamed for Increased Hospital Costs," Hospitals, Volume 38, June 16, 1964, p. 125.

2. Dr. Gerald L. Delon and Dr. Harold E. Smalley, Quantitative Methods for Evaluating Hospital Designs, Program Bulletin No. 5, Program in Hospital and Medical Systems, August, 1969.

3. Robert R. Cadmus, "Efficient Layout of the Radiology Department," Hospitals, Volume 40, May 1, 1966, p. 63.

4. Henry J. Gartland, "Blueprint for a Professional Hospital Library," Hospitals, Volume 38, June 16, 1964, p. 58.

5. "Planning the Nursing Unit," Hospitals, Volume 39, February 1, 1965, p. 65.

6. Isadore Rosenfield, Hospitals - Integrated Design, Reinhold Publishing Corporation, New York, 1947.

7. Nuffield Provincial Hospitals Trust, Studies in the Functions and Design of Hospitals, Oxford University Press, London, 1955.

8. Charles Butler and Addison Erdman, Hospital Planning, F. W. Dodge Corporation, New York, 1946.

9. E. Todd Wheeler, Hospital Design and Function, McGraw-Hill Book Company, New York, 1946.

10. Elwood S. Buffa, Gordon C. Armour, and Thomas E. Vollman, "CRAFT", Harvard Business Review, Volume 42, No. 2, March-April, 1964, pp. 136-148.

11. Robert E. Lee, and James M. Moore, "CORELAP - COmputerized RElationship LAyout Planning," Proceedings Eighteenth Annual Institute Conference and Convention American Institute of Industrial Engineers, 1967.

12. Edward H. Bowman and Robert B. Fetter, Analysis for Production and Operations Management, Yale University, 1967, p. 62.

13. Richard Muther, Systematic Layout Planning, Industrial Education Institute, Boston, Mass., 1961, p. 5- 2.

14. Richard Muther, Systematic Layout Planning, Industrial Education Institute, Boston, Mass., 1961, p. 5-1.

15. James M. Apple, Plant Layout and Materials Handling, The Ronald Press Company, New York, 1963, p. 174.

16. Richard Muther, Systematic Layout Planning, Industrial Education Institute, Boston, Mass., 1961, p. 5-2.

17. Webster's Third New International Dictionary, G.&C. Merriam Co., 1961, pp. 1584-1585.

18. Jerrold M. Seehof and Wayne O. Evans, "Automated Layout DEsign Program," Proceedings Eighteenth Annual Institute Conference and Convention American Institute of Industrial Engineers, 1967, pp. 281-287.

19. Wayne O. Evans, Automated Layout Design Program (ALDEP), Systems Analysis, Department 405, SDD IBM Development Laboratory, Rochester, Minnesota, June 4, 1968.

20. Webster's Third New International Dictionary, G.&C. Merriam Co., 1961, pp. 1117.

21. U. S. Department of Health, Education, and Welfare, Public Health Service, Medical School Facilities: Planning Considerations and Architectural Guide, Public Health Service Publication No. 875, Washington, D.C., 1960.

LITERATURE NOT CITED

1. Buchan, John Russel, An Evaluation of Selected Quantitative Methods Useful in Plant Layout, Thesis, Georgia Institute of Technology, Atlanta, Georgia, 1966.

2. Gottlieb, Symond R., "How Hospital Planners and City Planners Can Work Together," Hospitals, Volume 41, September 1, 1967, p. 65.

3. Mitchel, Stephen M., A Quantitative Method for Determining Optimal Plant Layout, Thesis, Georgia Institute of Technology, Atlanta, Georgia, 1966.

4. Stephan, James W., "Seven Planning Steps Set the Stage for Construction," Hospitals, Volume 40, May 1, 1966, p. 53.